DINOSAURS of the World

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DINOSAURS
# of the World

with an Introduction by
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2

Avialans – Chasmosaurus

Marshall Cavendish
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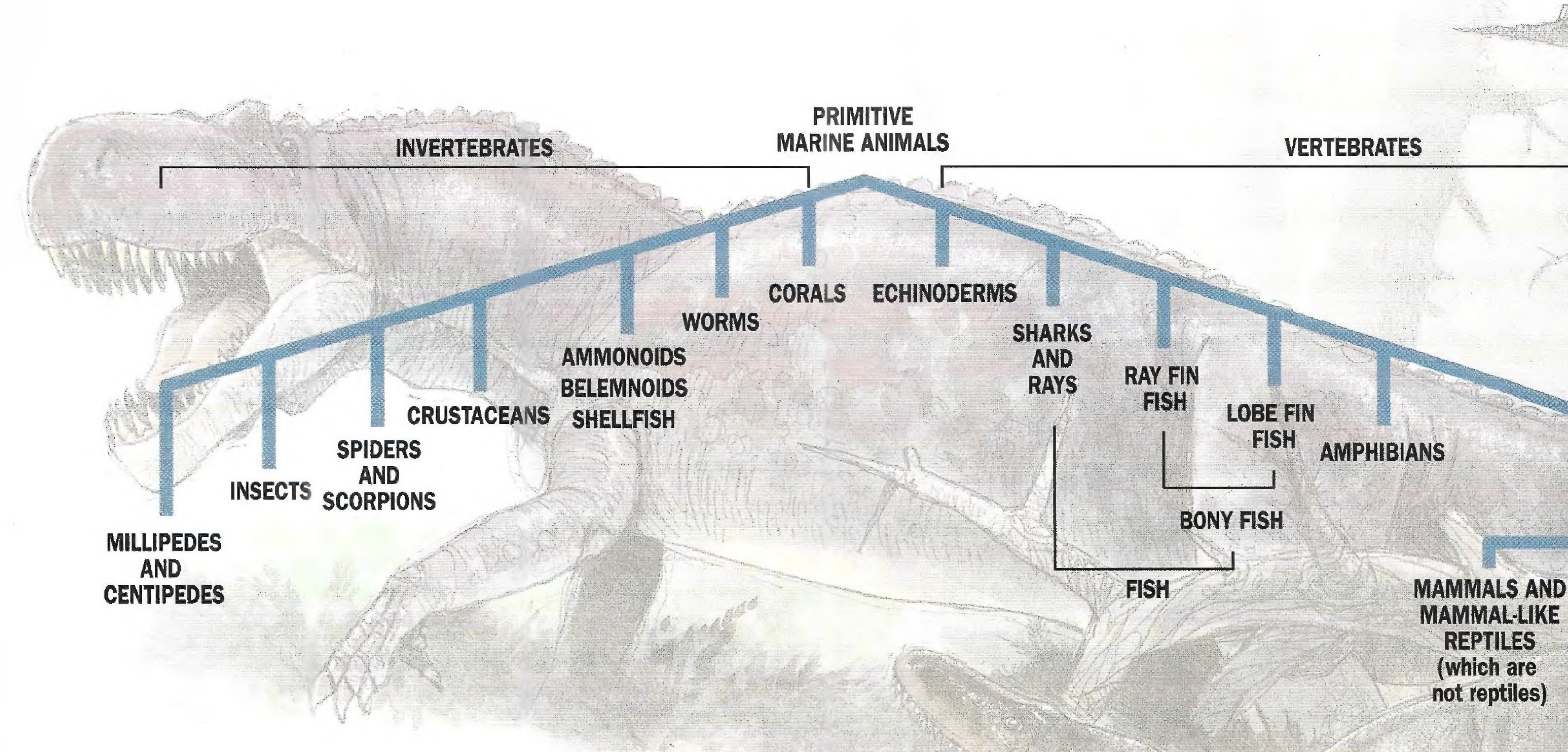
The tree of life

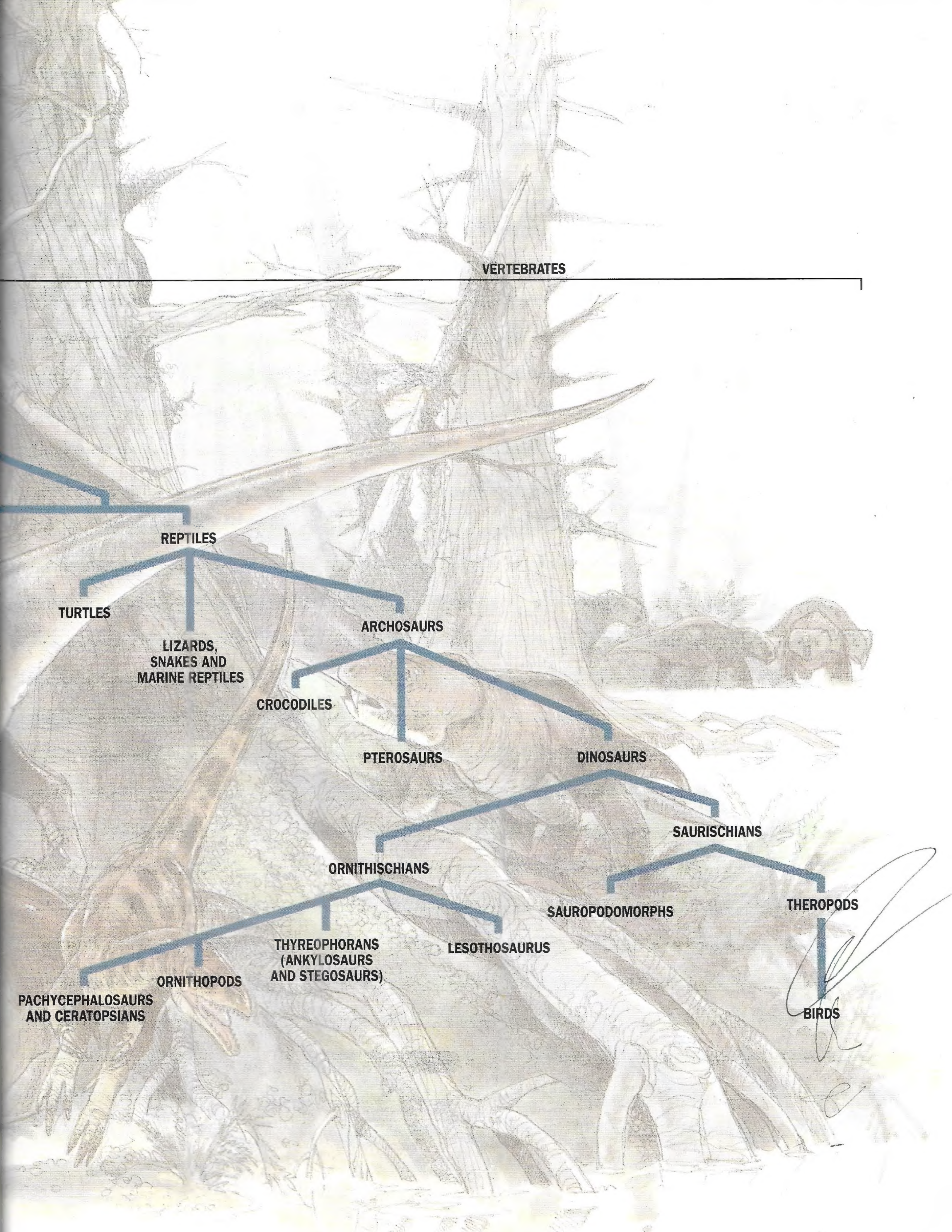


The history of life looks a bit like an upside-down tree. A common ancestor at the top diverges into different branches, and these branches into even more branches, and so on. The branches represent different groups of life-forms.

Scientists seek to understand just how this tree grew and how life-forms are related to one another. One of their methods is to identify special features. Every living thing has its own unique mix of features, for example, types of bones or numbers of fingers. Some features will be new (they have evolved on their own), and some features will be old (they were inherited from ancestors). By studying these features, or traits, we can climb backward on the tree of life to find out how different kinds of living things are related.

Let's start with birds. If you examined a bird's skeleton, you would find that it has a flexible neck joint. The first theropod (two-legged meat-eating dinosaur) also had a flexible neck joint. In our tree of life, a group of organisms includes the common ancestor and all of its descendants. For example, the theropod group includes the first theropod and all of its descendants, so scientists identify our bird as a theropod. The bird has a long neck that it inherited from the first saurischian dinosaur, so the bird is also considered a saurischian dinosaur. The bird's hip sockets allow it to walk with its legs held beneath its body. It inherited these hips from the first dinosaur, so our bird is also considered to be a dinosaur. The holes in its skull in front of its eye sockets came from the first archosaur, so we group it as an archosaur. Our bird has scales around its feet, which it inherited from its reptile ancestors, so it is also part of the reptile branch of the tree of life. Our bird has a backbone inside its body, so, like mammals, amphibians, and fish, it is also a vertebrate.

This diagram shows how groups of animals are linked. By following the tree upward from birds or from any group of animals, you can find out how the different groups of animals are related.


VERTEBRATES
REPTILES
TURTLES
LIZARDS, SNAKES AND MARINE REPTILES
ARCHOSAURS
CROCODILES
PTEROSAURS
DINOSAURS
SAURISCHIANS
ORNITHISCHIANS
SAUROPODOMORPHS
THEROPODS
THYREOPHORANS (ANKYLOSAURS AND STEGOSAURS)
LESOTHOSAURUS
ORNITHOPODS
PACHYCEPHALOSAURS AND CERATOPSIANS
BIRDS

Avialans

What do you call a dinosaur with wings and feathers? You call it an avialan. Avialans have been around since the Jurassic period. They are still with us today. Modern avialans are called birds.

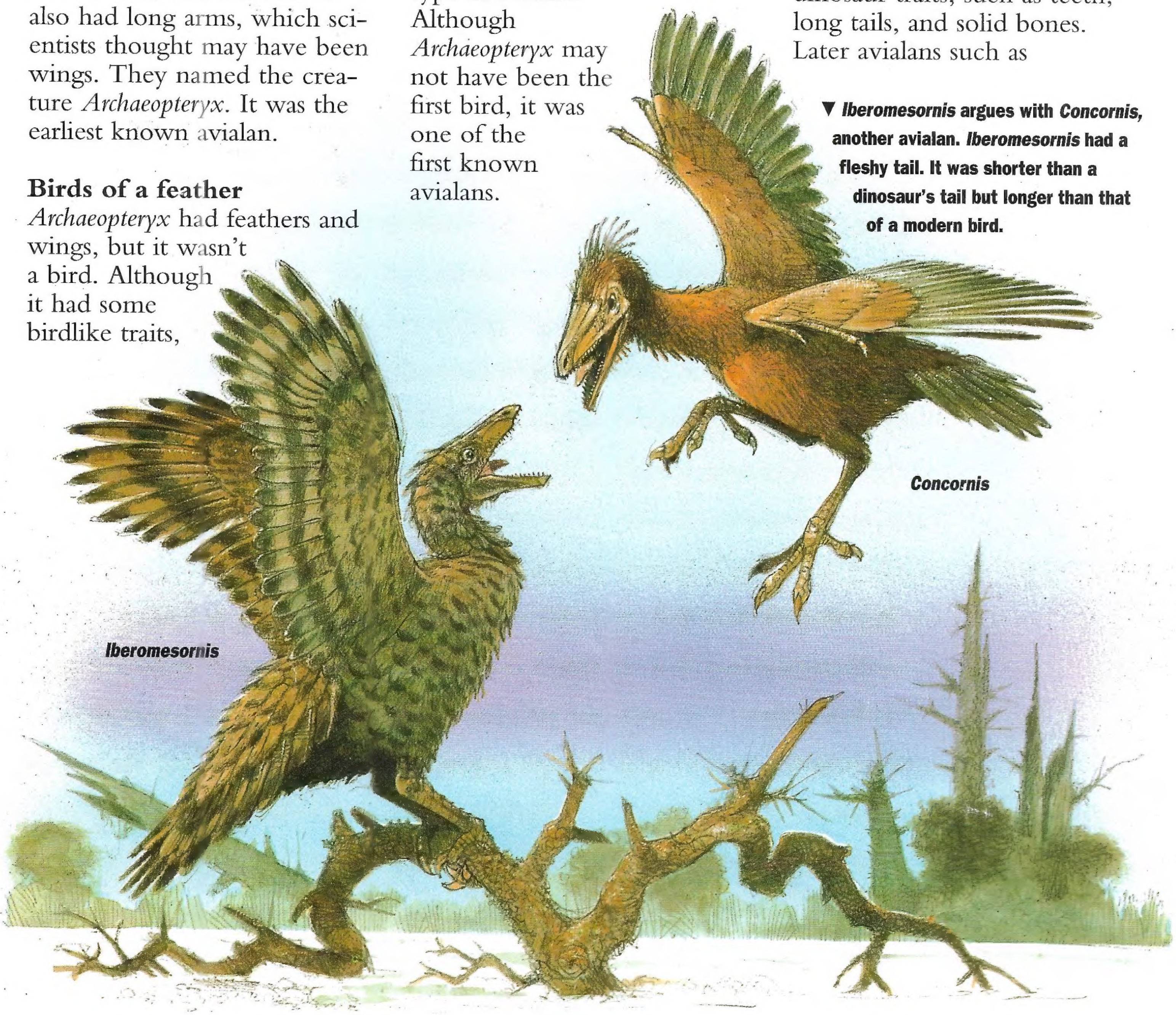
In 1861, fossil-hunters found the remains of an amazing creature in Germany. It looked a little like a dinosaur. However, the fossil showed the creature had feathers. It also had long arms, which scientists thought may have been wings. They named the creature *Archaeopteryx*. It was the earliest known avialan.

Birds of a feather

Archaeopteryx had feathers and wings, but it wasn't a bird. Although it had some birdlike traits, *Archaeopteryx* also had traits that birds do not have. It had teeth and a long tail. Birds do not have teeth, and their tail bones are very short. Birds are just a type of avialan. Although *Archaeopteryx* may not have been the first bird, it was one of the first known avialans.

Avialan moms and dads

Scientists believe avialans evolved from small meat-eating dinosaurs called coelurosaurs. The first avialans had many dinosaur traits, such as teeth, long tails, and solid bones. Later avialans such as



▼ *Iberomesornis* argues with *Concornis*, another avialan. *Iberomesornis* had a fleshy tail. It was shorter than a dinosaur's tail but longer than that of a modern bird.

FLIGHT PATHS

Scientists cannot agree on how avialans first flew. Did the first flying dinosaur take off from the ground? Was it perhaps running fast after an insect and then leaped into the air to catch it? Scientists think this explanation is possible.

There is also another explanation. We know *Archaeopteryx* climbed trees. Did the first flyers glide out of the tree tops like modern flying squirrels? Until more fossils are found, scientists cannot tell which explanation is right.

Iberomesornis (shown left) lost these traits. For example, they had a much shorter tail.

During the Cretaceous period, a group of avialans appeared that had short tails and no teeth. Their light, hollow bones made it easier for them to fly. These new kind of avialans were called birds.

How did avialans live?

The first avialans lived much like birds today. *Archaeopteryx* lived in trees beside marshes and fed on insects. Others, such as *Mononykus,* could not fly. It spent most of its time foraging for food on the ground.

Other avialans preferred the sea. *Hesperornis* was like a huge penguin. It also couldn't fly, so it floated on the ocean, diving after fish.

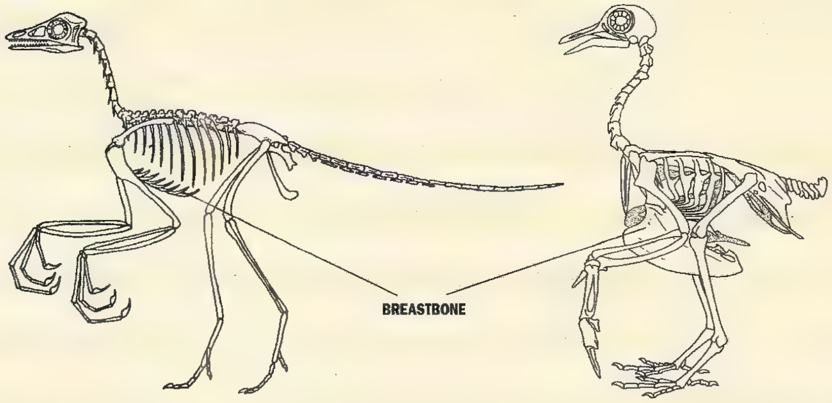
CHECK THESE OUT!

***Archaeopteryx*, *Avimimus*, Birds, Cretaceous period, *Hesperornis*, Jurassic period, Maniraptors, *Mononykus*, Saurischian dinosaurs, Theropods**

DINOFACTS

Avialans

(AY-vee-YAY-lans)



▲ The skeleton of *Archaeopteryx*. Look how dinosaurlike it is with its long tail and clawlike fingers.

▲ A pigeon has a huge breastbone to hold its flight muscles. It has no teeth, and its bony tail has almost vanished.

NAME: **Avialans means birds**
Avis (bird)

FAMILY: **Saurischian**
Theropod
Maniraptor

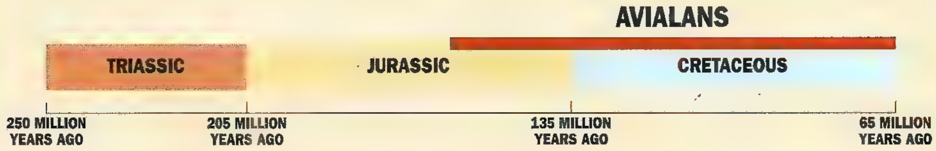
SIZE: **wide variation from 2.5 in (6 cm) to 3.3 ft (1 m) long**

FOOD: **insects and fish**

HABITAT: **cliffs, seashores, wetlands**

WHERE: **remains found worldwide**

WHEN: **155–65 million years ago in the Jurassic and Cretaceous periods**



Avimimus

Many dinosaurs looked more like birds than reptiles. *Avimimus*, if it existed, was one of the most birdlike dinosaurs. It would have had a big brain for its size and was probably pretty smart.

In the 1970s, Russian scientist Sergei Kurzanov found some strange fossil bones in Mongolia. He said they belonged to a creature called *Avimimus*. The bones puzzled Kurzanov. They were clearly the bones of a dinosaur. Yet, this dinosaur had many birdlike traits. Was *Avimimus* a dinosaur or a bird?

Kurzanov studied the bones closely. Many bones were missing, so he had to make guesses.

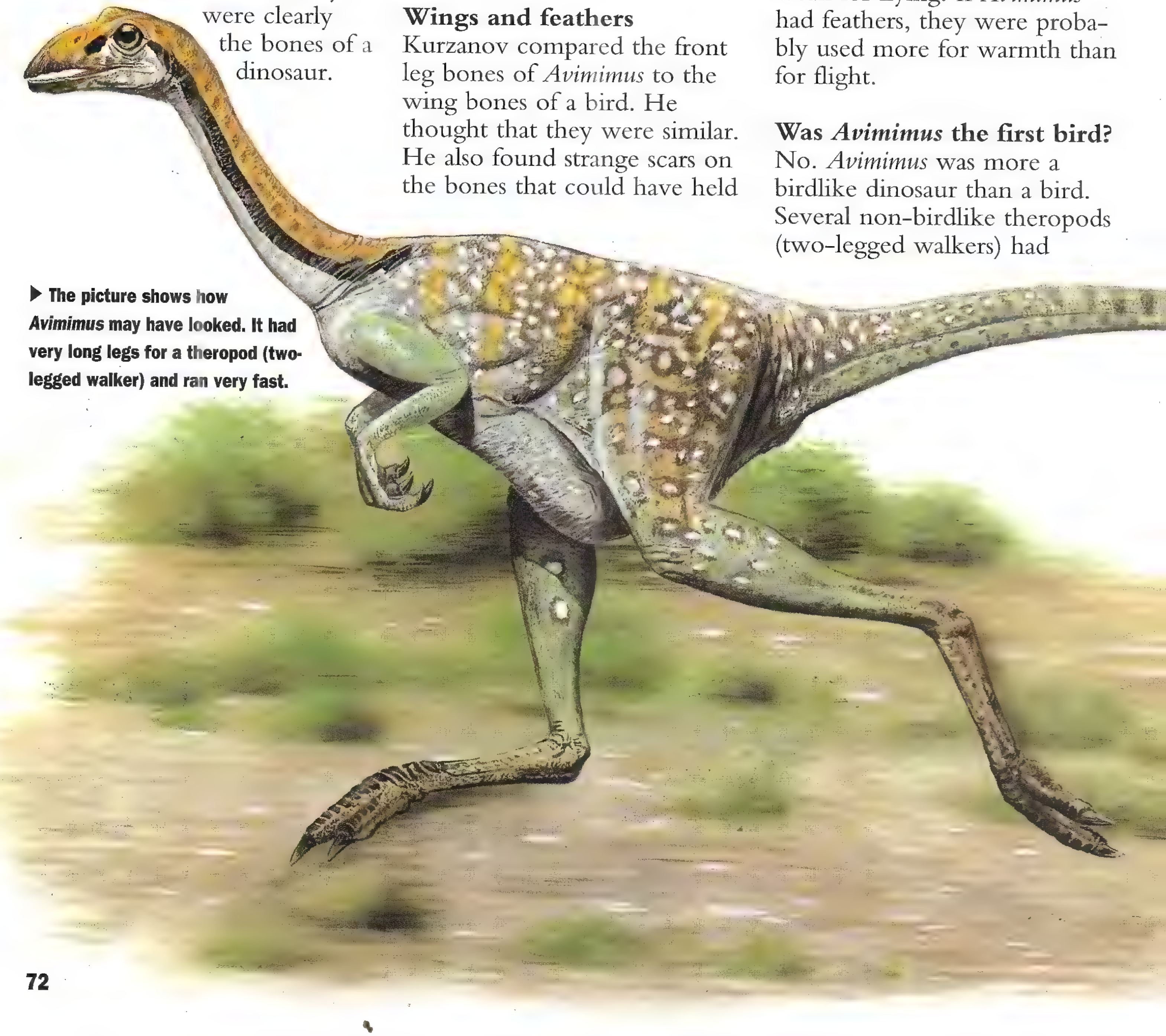
Wings and feathers

Kurzanov compared the front leg bones of *Avimimus* to the wing bones of a bird. He thought that they were similar. He also found strange scars on the bones that could have held feathers. Kurzanov wondered: did *Avimimus* have wings and feathers like a modern bird?

This question still puzzles scientists. If *Avimimus* did have wings, they were too small and weak for flying. If *Avimimus* had feathers, they were probably used more for warmth than for flight.

Was *Avimimus* the first bird?

No. *Avimimus* was more a birdlike dinosaur than a bird. Several non-birdlike theropods (two-legged walkers) had



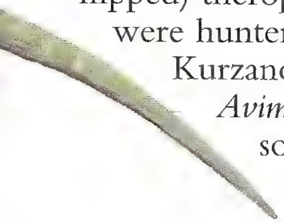
▶ The picture shows how *Avimimus* may have looked. It had very long legs for a theropod (two-legged walker) and ran very fast.

DINOSAUR QUARRELS

Kurzanov thought that *Avimimus* had feathers. Other scientists disagreed with this idea. Is it bad when scientists disagree? No. Quarrels like this one are usually good for science. Rather than argue, scientists gather evidence to support their idea. Over time, one idea wins the argument; the other idea loses. In the end everyone wins because they learn new knowledge.

feathers, so the presence of feathers in *Avimimus* does not make it a bird.

More importantly, scientists are not sure if *Avimimus* ever lived. They think it may be a hodgepodge of several dinosaurs.



How did *Avimimus* live? *Avimimus*, if it ever existed, was a small, saurischian (lizard-hipped) theropod. Theropods were hunters. However, Kurzanov believed *Avimimus* had a beak, so he imagined that the dinosaur ate insects rather than meat.

Avimimus would have been hunted by meat-eating dinosaurs, such as *Troodon* and *Velociraptor*. Amazingly, these predators were also near relatives of *Avimimus*. *Velociraptor* was a fast and successful predator that hunted in packs.

CHECK THESE OUT!

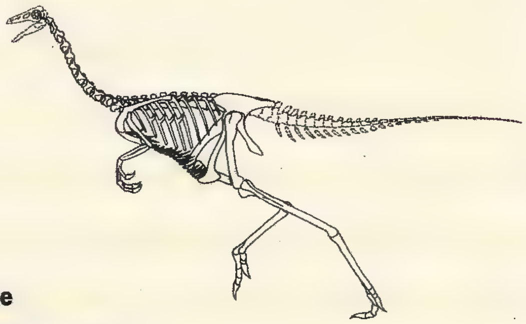
Archaeopteryx*, Avialans, Birds, Cretaceous period, Saurischian dinosaurs, Theropods, *Troodon*, *Velociraptor

DINOFACTS

Avimimus

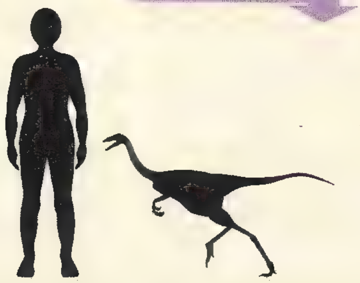
(AAH-vee-MY-mus)

▶ ***Avimimus* was a birdlike dinosaur, with a slender body, long neck, and slim legs. It had a beak and no teeth.**



NAME: *Avimimus* means birdlike
avis (bird) + mimos (mimic or copy)

FAMILY: Saurischian
Theropod



SIZE: 5 ft (1.5 m) long; 2 ft (60 cm) high at the hip

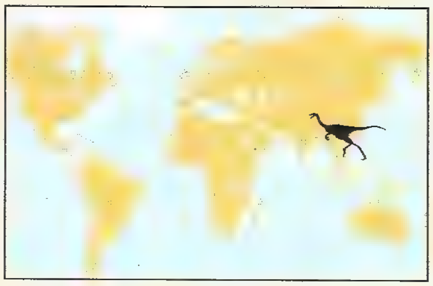
WEIGHT: 31 lbs (14 kg)—about the same as a large turkey

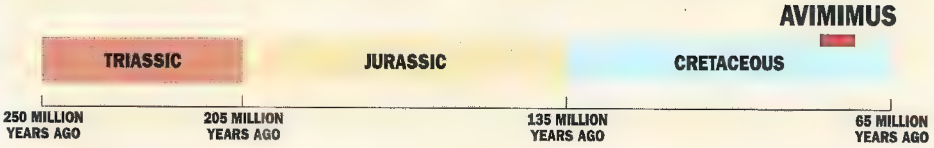
FOOD: meat or insects

HABITAT: arid steppe and desert

WHERE: remains found in Mongolia and China

WHEN: 85–75 million years ago in the Cretaceous period





Bactrosaurus

When it was discovered, *Bactrosaurus* puzzled scientists. It seemed to be a hadrosaur, or duckbill dinosaur. But something was missing. Where was the crest?

Bactrosaurus was one of the first duckbill dinosaurs. Or was it? Duckbill dinosaurs were a group of plant-eating dinosaurs that lived during the Cretaceous period. Most duckbills had a bump on their head called a crest. Some crests were hollow. Others were solid. *Bactrosaurus* seemed to have no crest. So why was it a duckbill?

To find an answer to this question, scientists looked at other parts of this dinosaur's body. They found that like other hadrosaurs (duckbills), *Bactrosaurus* had no thumbs, no front teeth, it had a duckbill mouth, and it had an *Iguanodon*-shaped body (*Iguanodon* was an earlier plant-eating dinosaur).

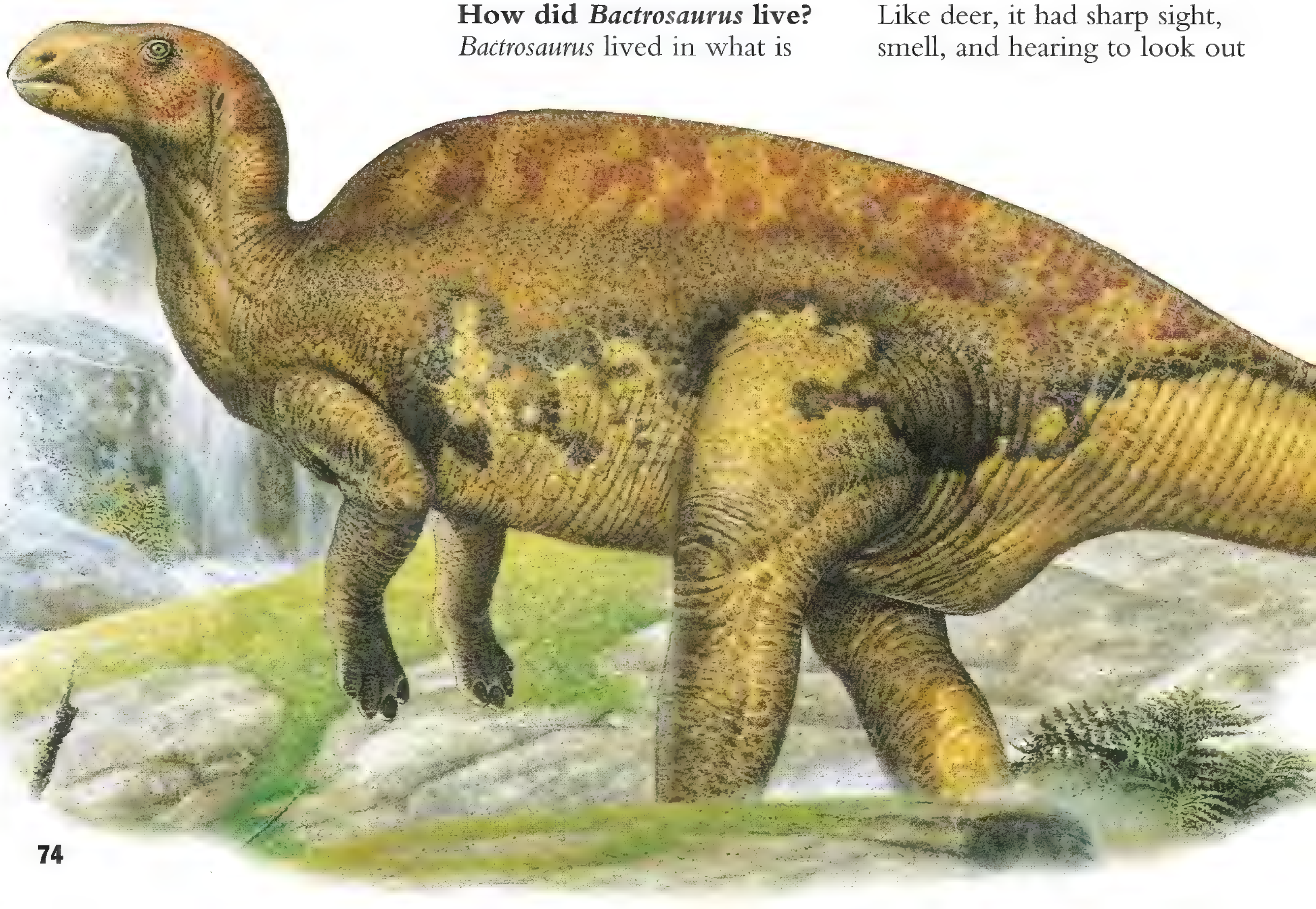
Bactrosaurus was an early hadrosaur. It lived at least 10 million years before most other hadrosaurs. *Bactrosaurus* was also smaller and less advanced than some other hadrosaurs.

How did *Bactrosaurus* live?

Bactrosaurus lived in what is now Asia. It was discovered on a trip to the Gobi desert in Mongolia in 1923. *Bactrosaurus* was a browser. It probably ate huge amounts of rough plant material. This may have included twigs and leaves the dinosaur plucked from trees and bushes with its strong beak. The animal would have ground the leaves and twigs with its teeth.

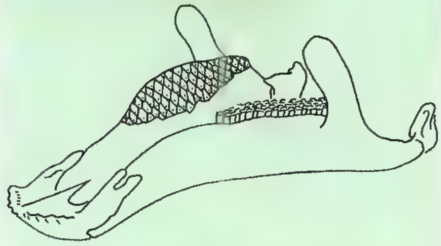
Escaping enemies

Bactrosaurus was not a fighter. Like deer, it had sharp sight, smell, and hearing to look out



HADROSAUR TEETH

All hadrosaurs had many teeth. They were densely arranged on both sides of the upper and lower jaws in rows, each composed of hundreds of teeth. The teeth would have been capable of grinding and breaking even the toughest woody twigs.



▲ The lower jaw had hundreds of teeth; the upper jaw did too.

for predators. When approached by a meat-eating dinosaur, it used its long, powerful legs to run away.

New findings

Recent dinosaur digs have found new head bones for *Bactrosaurus*. These bones show that *Bactrosaurus* may have had a small crest after all.

CHECK THESE OUT!

Cretaceous period,
Hadrosaurs, *Iguanodon*,
Ornithischian dinosaurs, Ornithopods

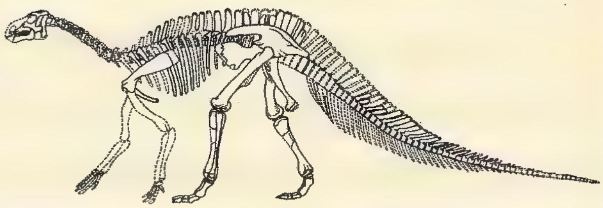
◀ *Bactrosaurus* probably spent much of its time on all fours. Scientists also believe it could walk on two legs, too.

DINOFACTS

Bactrosaurus

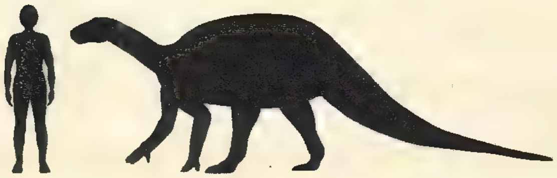
(BAK-truh-SORE-us)

▶ The skeleton of *Bactrosaurus* shows how large the dinosaur's tail was. The tail would have helped it to balance when it moved on two legs.



NAME: *Bactrosaurus* means lizard from Bactria
Bactria (province of Asia) + sauros (lizard)

FAMILY:
Ornithischian
Ornithopod
Hadrosaur



SIZE: 13–20 ft (4–6 m) long; 5 ft (1.5 m) high at the hip

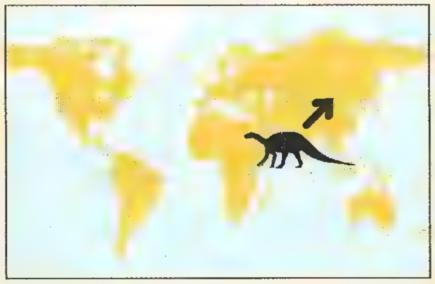
WEIGHT: 1–3 tons (0.9–2.7 tonnes)—about the same as 1–3 American bison

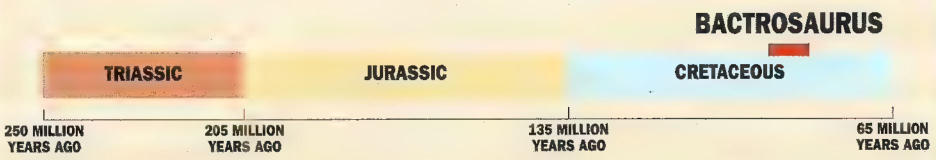
FOOD: plants

HABITAT: dryish upland floodplains

WHERE: remains found in Mongolia

WHEN: 95–85 million years ago in the Cretaceous period





Bagaceratops

In 1975, a group of Polish scientists described the remains of a new dinosaur in Mongolia. The dinosaur was a small ceratopsian, or horned dinosaur, later named *Bagaceratops*.

Bagaceratops was a horned dinosaur, like *Triceratops*. While *Triceratops* had three big horns, *Bagaceratops* had only one small horn on its nose.

Most ceratopsians have a bony mane on the back of their head, called a frill. *Triceratops* had a huge bony fan of a frill. *Bagaceratops* had just a tiny frill.

How could *Bagaceratops* look so different from *Triceratops* and still be a ceratopsian? Because *Bagaceratops* belonged to a group of horned dinosaurs called protoceratopsians. These animals had only small horns and neck frills—sometimes none at all. Only the later ceratopsians had big horns and large neck frills.

How were neck frills used?

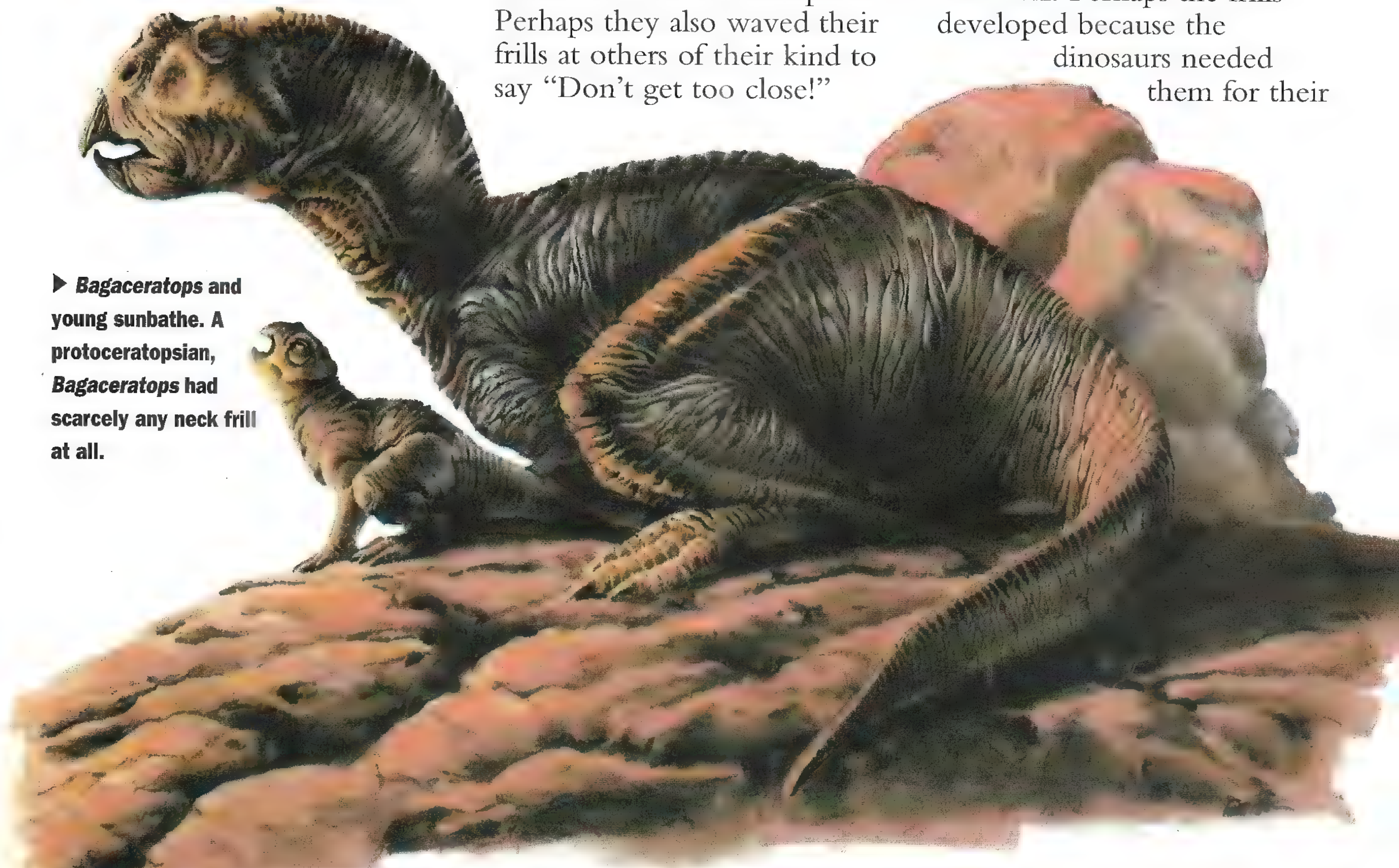
No one knows for sure how these dinosaurs used their neck frill. The frill may have helped ceratopsians recognize dinosaurs of their own species. Perhaps they also waved their frills at others of their kind to say "Don't get too close!"

Chewing machine

The frill would also have helped *Bagaceratops* to eat.

Bagaceratops, like other ceratopsians, fed on tough plant material. It had a short snout with a beaklike mouth. It used its beak to gather food. Then it cut up the food with its teeth before swallowing it.

Bagaceratops needed powerful jaw muscles to munch through this rough material. The big jaw muscles were fixed to its neck frill. Perhaps the frills developed because the dinosaurs needed them for their



▶ ***Bagaceratops*** **and young sunbathe. A protoceratopsian,** ***Bagaceratops*** **had scarcely any neck frill at all.**

GROWING UP

Fossil-hunters have never found a complete skeleton of *Bagaceratops*. Even so, scientists have learned a lot from the *Bagaceratops* remains they have discovered. The remains include skulls of young and adult dinosaurs. Because skulls are so fragile, fossilized ones are very rare. Fossilized skulls from dinosaurs of many ages are even more rare.

These skulls show scientists how *Bagaceratops* changed as it grew. *Bagaceratops* seems to have begun life with a roundish head. It also had very big eyes. As it grew, its snout became a little longer. This change made the dinosaur's eyes seem smaller, although they really stayed the same size. It was just their head that grew. As for the frill, first it grew longer. Then it got wider.

jaw muscles. Scientists need to find more evidence before they know for certain how *Bagaceratops* used its neck frill.

How did *Bagaceratops* live?

Bagaceratops could have moved on two or four legs. It could have walked on four when it was feeding.

Bagaceratops had long, narrow feet and powerful hind legs. So it could have run fast. Scientists need to find more parts of *Bagaceratops*' skeleton to tell. Some good footprints would help.

CHECK THESE OUT!

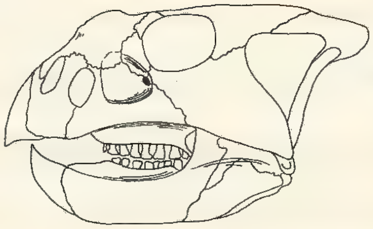
Ceratopsians, Cretaceous period, Footprints, Ornithischian dinosaurs, *Protoceratops*, *Triceratops*

DINOFACTS

Bagaceratops

(BAG-a-SAIR-uh-TOPS)

▶ The skull of *Bagaceratops* shows the dinosaur's small neck frill. The nose horn is little more than a bump. Like all ceratopsians, *Bagaceratops* has a parrotlike beak.



NAME: ***Bagaceratops*** **means small horned-face**
baga (small) + keratos (horned) + ops (face)

FAMILY: **Ornithischian**
Ceratopsian

SIZE: 3 ft (about 1 m) long; 1 ft (30 cm) high at the hip

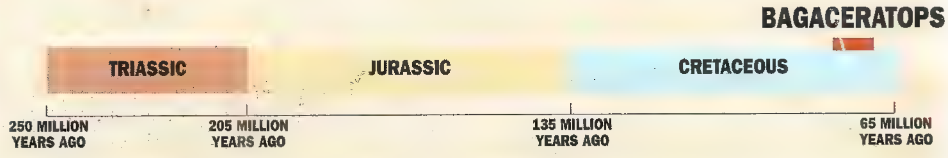
WEIGHT: 15–22 lbs (7–10 kg)—about the same as a small dog

FOOD: plants

HABITAT: dryish upland floodplains

WHERE: remains found in Mongolia

WHEN: 80–70 million years ago in the Cretaceous period



Barapasaurus

Barapasaurus was a plant-eating heavyweight that wandered the lowland forests of India in the Early Jurassic period. Fossil-hunters first found remains of this giant in 1959.

Scientists often find it difficult to decide to which group a dinosaur belongs. This happens especially when the dinosaur has traits of more than one group. When scientists first studied *Barapasaurus*, they could not tell if it had been a sauropod or a prosauropod.

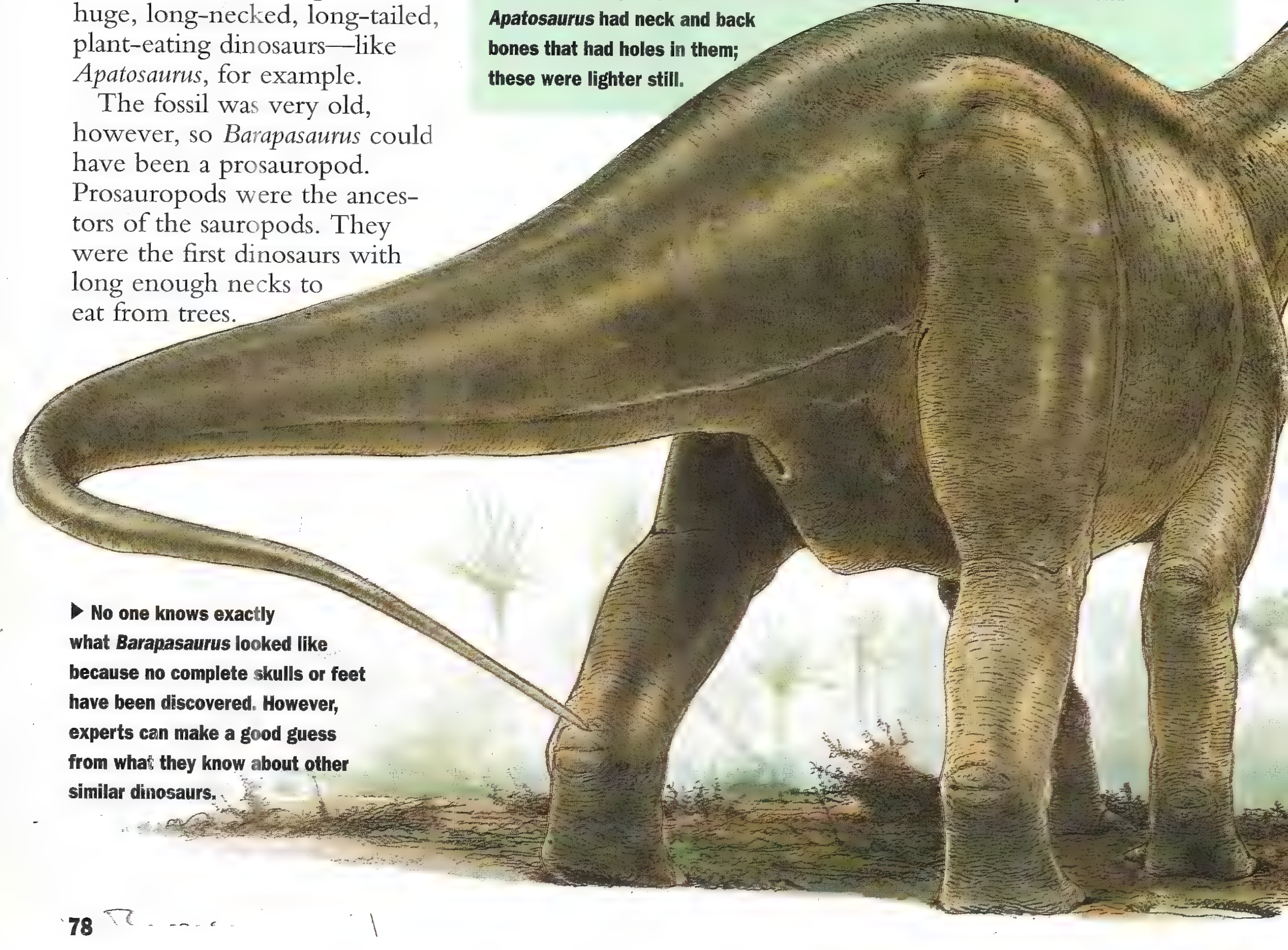
Barapasaurus was a lot like the sauropods. Sauropods were huge, long-necked, long-tailed, plant-eating dinosaurs—like *Apatosaurus*, for example.

The fossil was very old, however, so *Barapasaurus* could have been a prosauropod. Prosauropods were the ancestors of the sauropods. They were the first dinosaurs with long enough necks to eat from trees.

NOT THE FIRST SAUROPOD

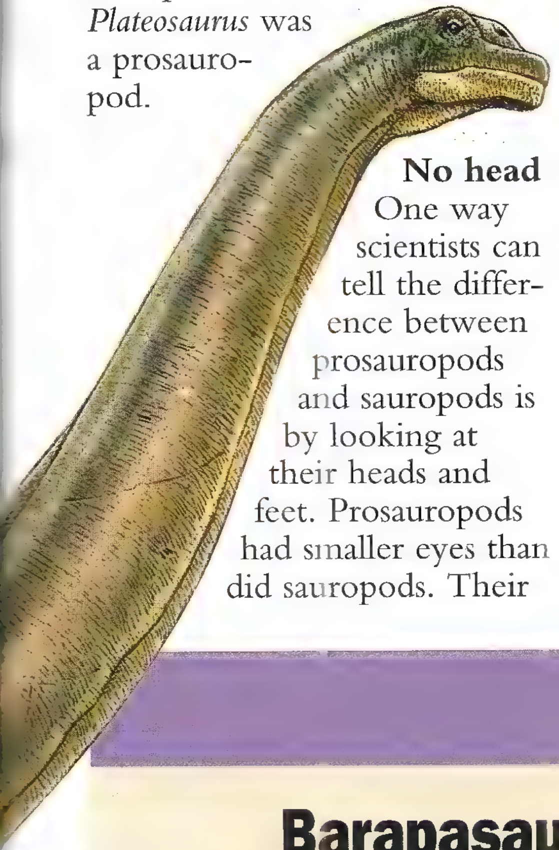
Although paleontologists believe sauropods evolved in the Late Triassic period, they have not yet found enough fossil remains to prove this theory. *Barapasaurus* is one of the earliest sauropods for which scientists have found fossil remains. It appeared about 40 million years after scientists believe the very first sauropods existed.

***Barapasaurus* probably looked like most other sauropods, with a long neck and tail, and a bulky body. However its skeleton was different from that of sauropods like *Diplodocus* and *Apatosaurus*, which evolved later. *Barapasaurus* had dents on the outside of its neck and back bones. This adaptation would have made its huge neck bones a little lighter, and easier to lift. Later sauropods like *Diplodocus* and *Apatosaurus* had neck and back bones that had holes in them; these were lighter still.**



▶ No one knows exactly what *Barapasaurus* looked like because no complete skulls or feet have been discovered. However, experts can make a good guess from what they know about other similar dinosaurs.

Most were smaller than the sauropods. *Plateosaurus* was a prosauropod.



No head

One way scientists can tell the difference between prosauropods and sauropods is by looking at their heads and feet. Prosauropods had smaller eyes than did sauropods. Their forefeet were like hands; sauropods' forefeet looked like elephant feet.

No one has found a *Barapasaurus* skull, or any of its feet. However, by studying its other bones, scientists found that *Barapasaurus* was not only a sauropod, it was also a close relative of *Cetiosaurus*.

How did *Barapasaurus* live?

Barapasaurus probably spent almost all its time feeding. Lumbering from tree to tree, it picked off pound upon pound of leaves from high branches with its teeth.

Barapasaurus may have lived in herds. In 1961, fossil-hunters found the remains of more than 300 *Barapasaurus* in a small area of southern India. It is unusual to find so many bones in one place. Perhaps a herd of *Barapasaurus* drowned while crossing a river.

CHECK THESE OUT!

***Apatosaurus*, *Cetiosaurus*, *Diplodocus*, Jurassic period, *Plateosaurus*, Prosauropods, Saurischian dinosaurs, Sauropodomorph dinosaurs, Sauropods, Triassic period**

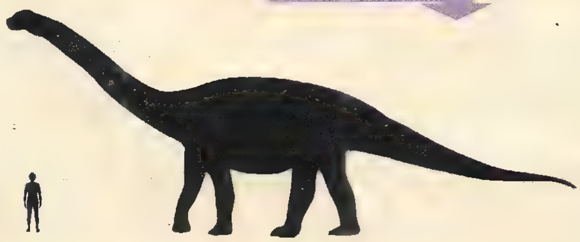
DINOFACTS

Barapasaurus

(buh-RAP-uh-SORE-us)

✳ **NAME:** ***Barapasaurus*** **means big-legged lizard**
bara (big) + pa (leg) + sauros (lizard)

○ **FAMILY:** **Saurischian → Sauropodomorph → Sauropod**



SIZE: 60 ft (18.3 m) long; 15 ft (4.6 m) high at the hip

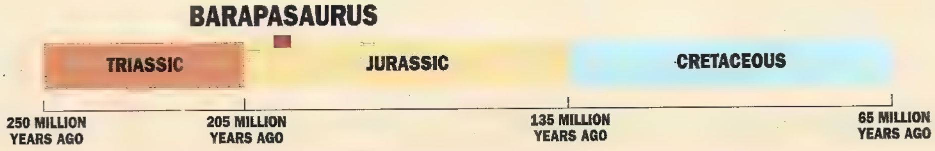
WEIGHT: 10–40 tons (9–36 tonnes)—about the same as 2–8 African elephants

FOOD: tree leaves

HABITAT: lowland open forest

WHERE: remains found in Deccan, southern India

WHEN: 195–190 million years ago in the Jurassic period



Barosaurus

Barosaurus was a sauropod—a big, long-necked, long-tailed, plant-eating dinosaur. It was named by the American paleontologist Othniel C. Marsh.

American fossil-hunters first found *Barosaurus* in 1890 in South Dakota. They dug up bones that looked a lot like those of another sauropod they already knew, called *Diplodocus*. However, these bones were different. Each neck bone was almost 4 ft (1.2 m) long! This had to be a brand new dinosaur.

Barosaurus had longer neck bones than *Diplodocus*. Not surprisingly, its neck was longer, too—up to 30 ft (9 m) long! That's twice as long as most giraffe necks are today. How did such a long neck help *Barosaurus*?

Food! *Barosaurus* lived near many other sauropods. Like a giraffe, because of its longer neck, *Barosaurus* could feed on the leaves that other sauropods could not reach.

Rearing up on hind limbs

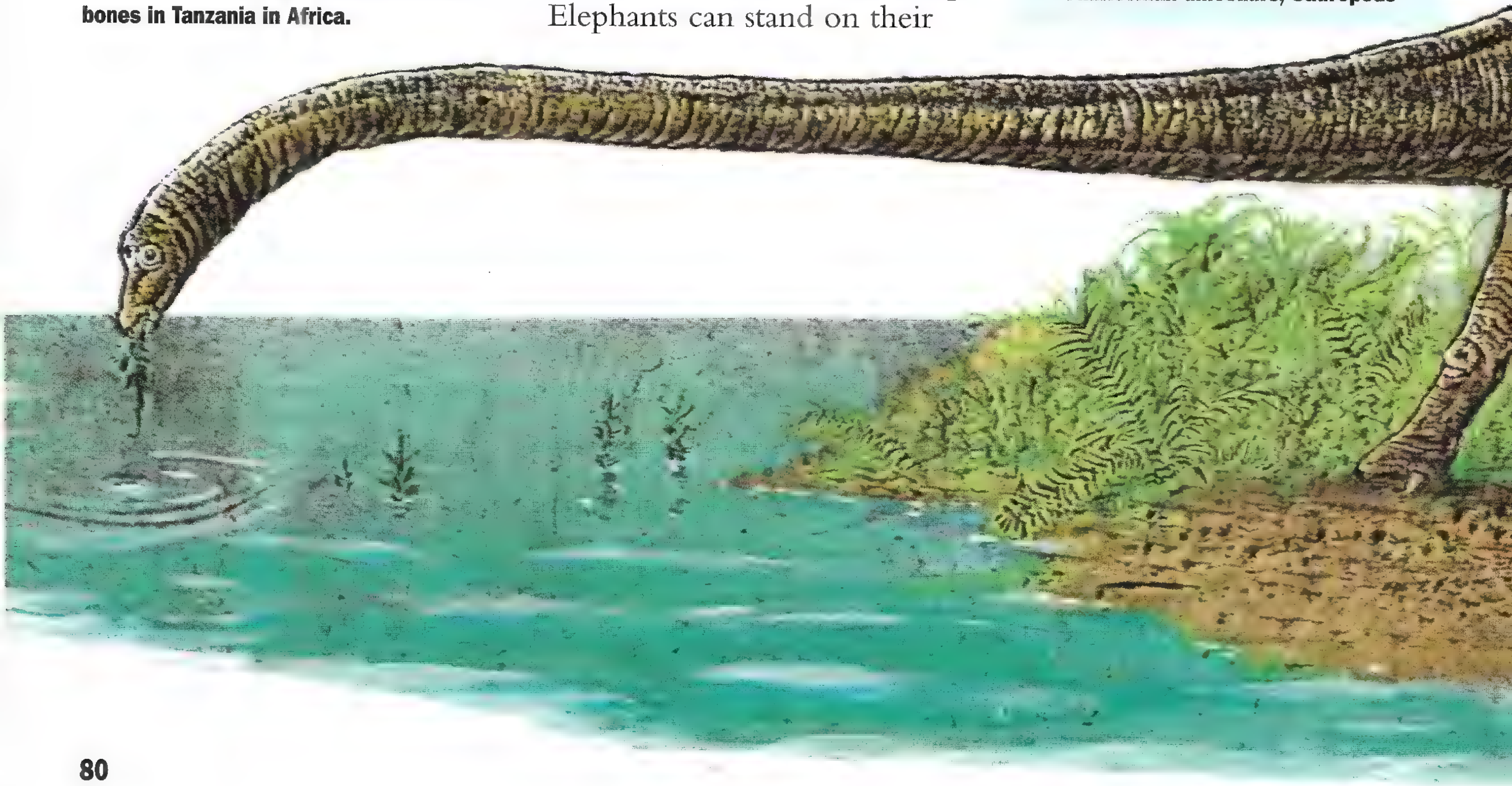
Could *Barosaurus* stand on its hind legs? A display in the American Museum of Natural History in New York shows *Barosaurus* doing just that. It is protecting its young from a meat-eating *Allosaurus*. Scientists think *Barosaurus* probably could have reared up. Elephants can stand on their hind limbs, so why not sauropods? Scientists are not sure *Barosaurus* did rear up, though. They cannot tell from the dinosaur's bones and they have found no *Barosaurus* footprints that prove it.

How did *Barosaurus* live?

Barosaurus wandered through swampy forests. Because of its huge size and small head, it probably spent most of its time feeding so that it could get enough food to stay alive.

CHECK THESE OUT!

***Allosaurus*, *Diplodocus*, Jurassic period, Saurischian dinosaurs, Sauropods**



▼ In 1908, almost 20 years after *Barosaurus* was first discovered in North America, a team found more *Barosaurus* bones in Tanzania in Africa.

ROCKS IN YOUR STOMACH

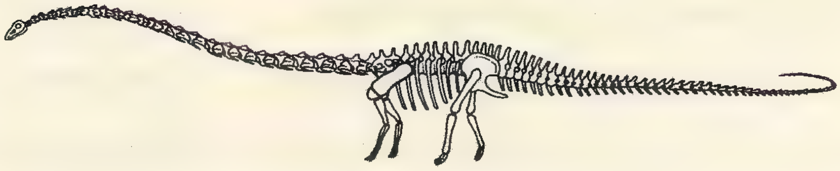
Scientists discovered 64 polished stones with one *Barosaurus* skeleton from Colorado. What were they doing there? Scientists believe that the dinosaur deliberately swallowed them.

Once inside the animal's stomach, the stones may have helped to grind up the tough plant food that *Barosaurus* ate. *Barosaurus* had teeth, but they were for snipping leaves from trees. The dinosaur swallowed leaves and shoots whole and relied on the stones, or gastroliths, to grind its food up in its stomach.

DINOFACTS

Barosaurus

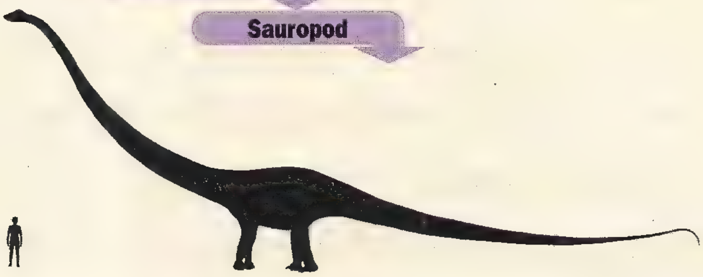
(BAR-oh-SORE-us)



▲ *Barosaurus* is very rare. Only five skeletons have been found, and they were all missing pieces. The most complete skeleton was discovered at Dinosaur National Monument in Utah.

NAME: *Barosaurus* means heavy lizard
baros (heavy) + sauros (lizard)

FAMILY: Saurischian
Sauropodomorph
Sauropod

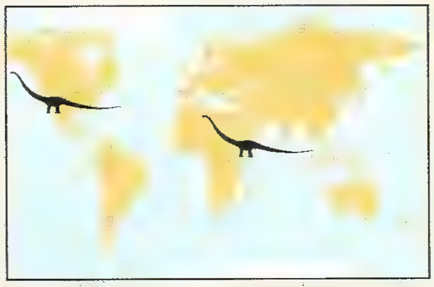


SIZE: 60 ft (18.3 m) long; 15 ft (4.6 m) high at the hip

WEIGHT: 10–40 tons (9–36 tonnes)—about the same as 2–8 African elephants

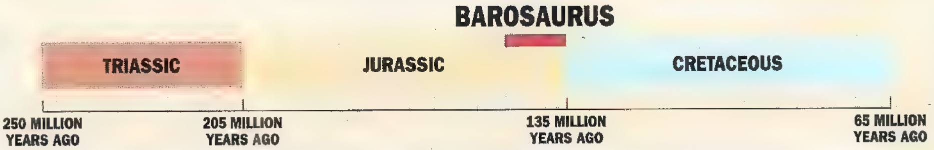
FOOD: plants

HABITAT: lowland open forest



WHERE: remains found in South Dakota, Wyoming, Colorado in the United States, and Tanzania in East Africa

WHEN: 150–135 million years ago in the Jurassic period



Baryonyx

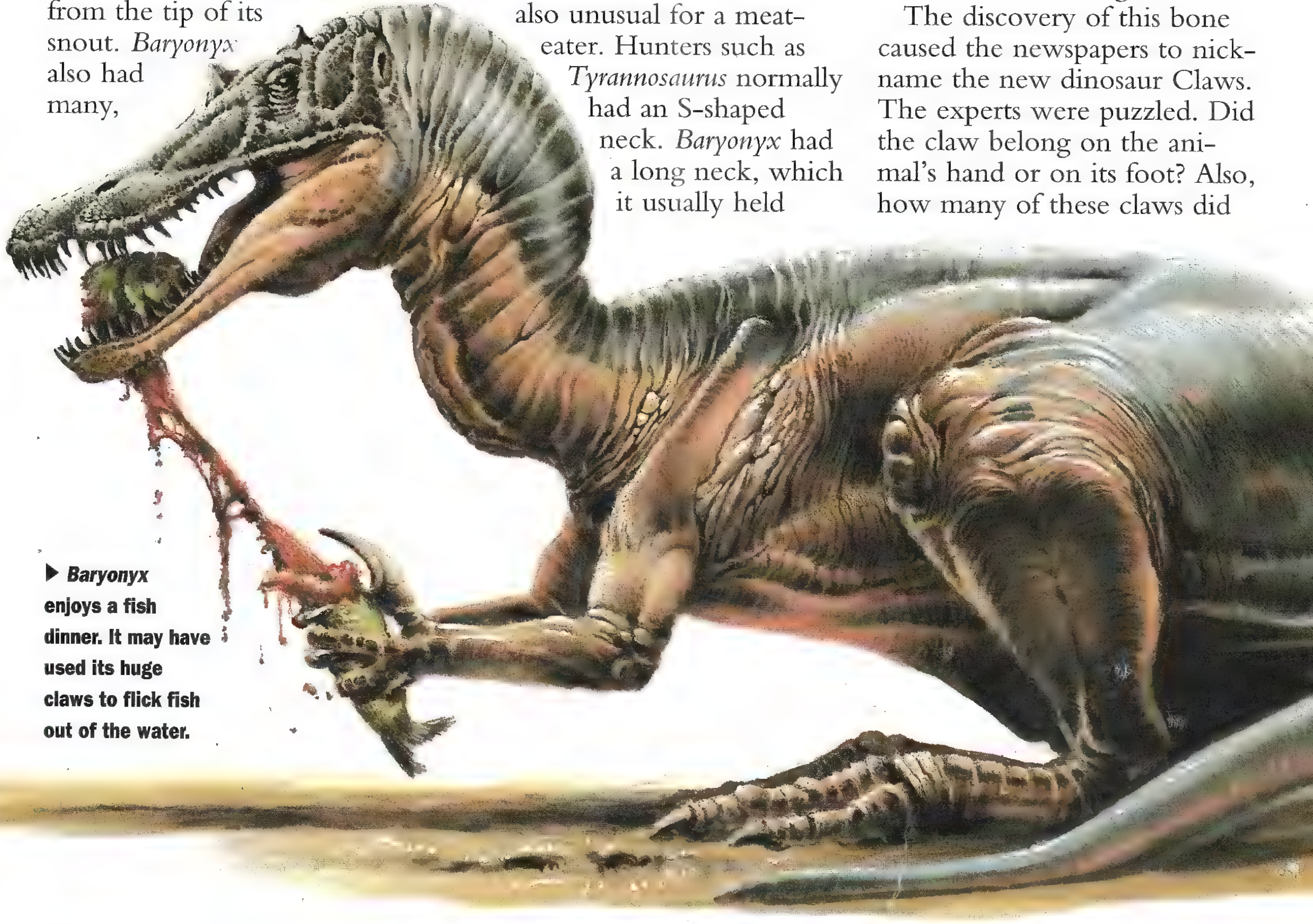
Scientists first studied *Baryonyx* during the 1980s. Some think it might have been a scavenger. Others believe it hunted fish. Who do you think is right?

When scientists first discovered *Baryonyx,* they soon realized that it looked different from other meat-eating dinosaurs. First, its head was an unusual shape. Meat-eating dinosaurs normally had fairly short snouts. *Baryonyx* had a long snout, though, like a crocodile. The snout turned down slightly at the end, and the animal's nostrils were a long way from the tip of its snout. *Baryonyx* also had many, many small pointed teeth—twice as many teeth as most other meat-eating dinosaurs. Scientists think that *Baryonyx* may have been closely related to *Spinosaurus*, another meat-eating dinosaur that lived in the Cretaceous period, too.

Claws

Besides its snout and teeth, other parts of *Baryonyx* were also unusual for a meat-eater. Hunters such as *Tyrannosaurus* normally had an S-shaped neck. *Baryonyx* had a long neck, which it usually held straight. *Baryonyx* had large, strong arms, too. The most unusual part of *Baryonyx*, though, was the huge claw bone found with the dinosaur's remains. The claw bone was 12 in (30 cm) long. When the dinosaur was alive, the claw bone would have been covered in tough horn, like a huge fingernail. It would have looked twice as long!

The discovery of this bone caused the newspapers to nickname the new dinosaur Claws. The experts were puzzled. Did the claw belong on the animal's hand or on its foot? Also, how many of these claws did



▶ *Baryonyx* enjoys a fish dinner. It may have used its huge claws to flick fish out of the water.

Baryonyx have? *Baryonyx* probably had two claws, one on each hand, but scientists are still not sure.

MR. WALKER'S *BARYONYX*

Can you imagine having a dinosaur named after you? That is exactly what happened to Mr. William Walker. In January 1983, Mr. Walker made an amazing discovery in southern England. He was a plumber, but he searched for fossils in his spare time. During one of his fossil hunts, he came upon the remains of a huge claw. He guessed the claw must belong to a new kind of dinosaur. He took his find to the Natural History Museum in London.

That spring, the museum sent a team of experts to dig in the area where Mr. Walker had found the claw. The scientists discovered much of the dinosaur's skeleton. They cleaned up the bones and studied what they had. Yes, it was definitely a new dinosaur. The scientists called it *Baryonyx*, and that is what it is usually known as. However, the dinosaur's full name is *Baryonyx walkeri*, in honor of Mr. Walker.

What *Baryonyx* ate

So why did *Baryonyx* look so unusual? Food! *Baryonyx* could have eaten fish. The long, crocodilelike snout and many pointed teeth would have been ideal for catching slippery fish.

Having nostrils far from the tip of its snout would have made it easier to eat fish, too. *Baryonyx* would have been able to put its head underwater to look for fish and still be able to breathe. It could not have done that if its nostrils had been near the tip of its snout, like those of *Tyrannosaurus*.

The head of *Baryonyx* looked a little like that of a phytosaur, a crocodilelike reptile related to the dinosaurs. Phytosaurs lived in the Triassic period (250–205 million years ago) and are thought to have eaten fish.

There is more evidence that *Baryonyx* may have eaten fish. Remember the big, strong arms that *Baryonyx* had? Why would a dinosaur need such strong arms when it probably walked on two legs? Or did *Baryonyx* crouch on all fours on river banks as it fished? Some experts think so.

What about the dinosaur's neck? Well, this would probably have helped *Baryonyx* reach down into the water to snap up fish. On top of all this evidence, scientists have even found fish scales in the same rocks as *Baryonyx* remains.

Did it eat fish?

Not necessarily. There are a few things that have not been explained. First, if *Baryonyx* caught fish with its teeth, why did it have claws on its hands? Well, say the scientists who think *Baryonyx* was a fish-eater, they might have been extra tools for catching fish. *Baryonyx* might have used them to flick fish out of the water. Grizzly bears use their claws in this way to catch salmon today.

That sounds fine, except for one thing. *Baryonyx* could weigh four times as much as the largest grizzly bear ever found. Would it not have been a bit too slow to catch fish? Yes, say a second group of scientists. *Baryonyx* was not a fish-eater, they say. It was a scavenger. In other words, *Baryonyx* fed on the bodies of land animals that were already dead.

A very long nose

What makes these scientists think that *Baryonyx* was a scavenger? Again it has to do with the dinosaur's unusual looks. This second group of scientists explain them differently. They think that *Baryonyx*'s long snout was ideal for poking about inside the bodies of dead dinosaurs. It would have used its small, pointed teeth to grip the slippery guts. It would then have feasted on the soft, gooey bits. The nostrils far back from the tip of its snout would let it breathe while its head was buried deep in the carcass.

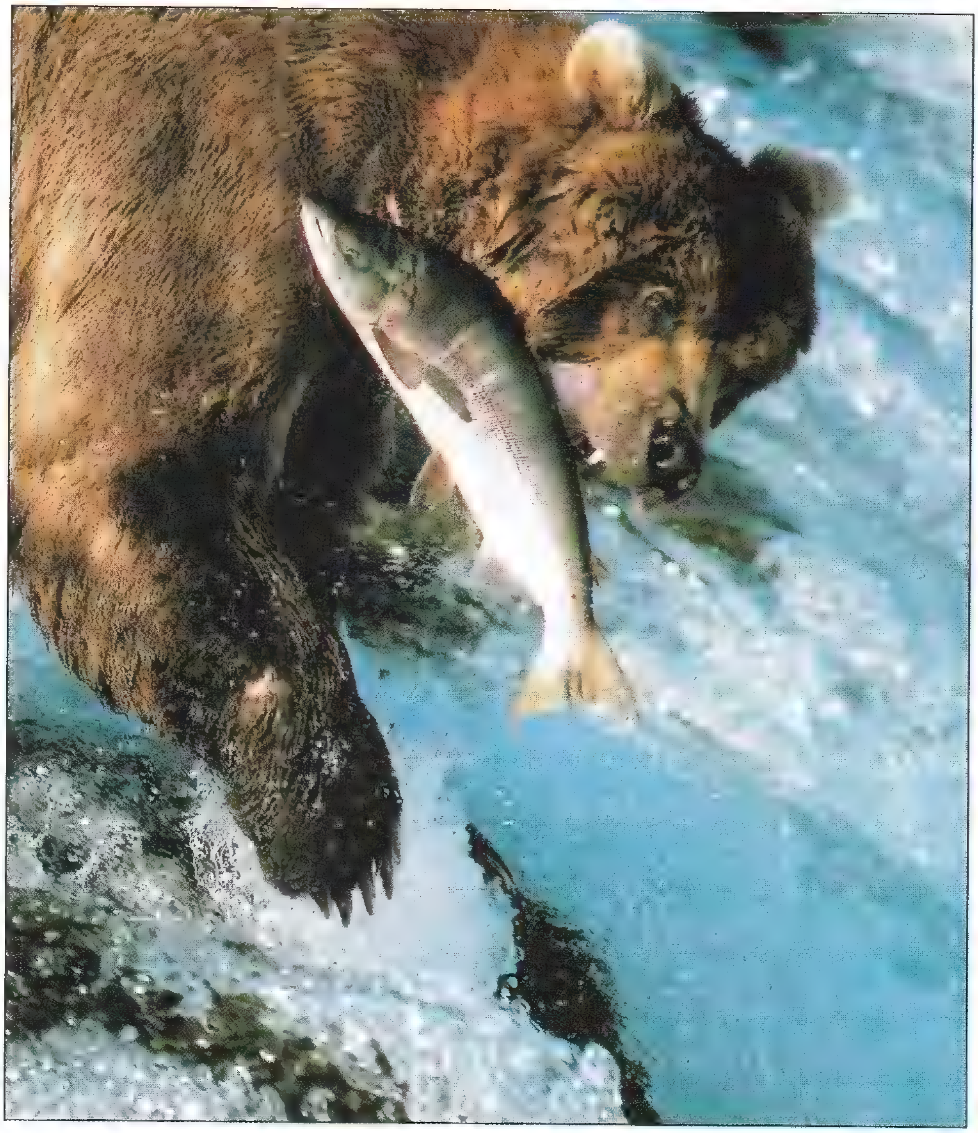
What about *Baryonyx*'s strong arms and neck? Those could have been just as useful for scavenging as for catching fish. Standing on all fours meant *Baryonyx* didn't have to bend over to feed on the ground. Its long neck helped it reach its food.

Skin-ripping claws

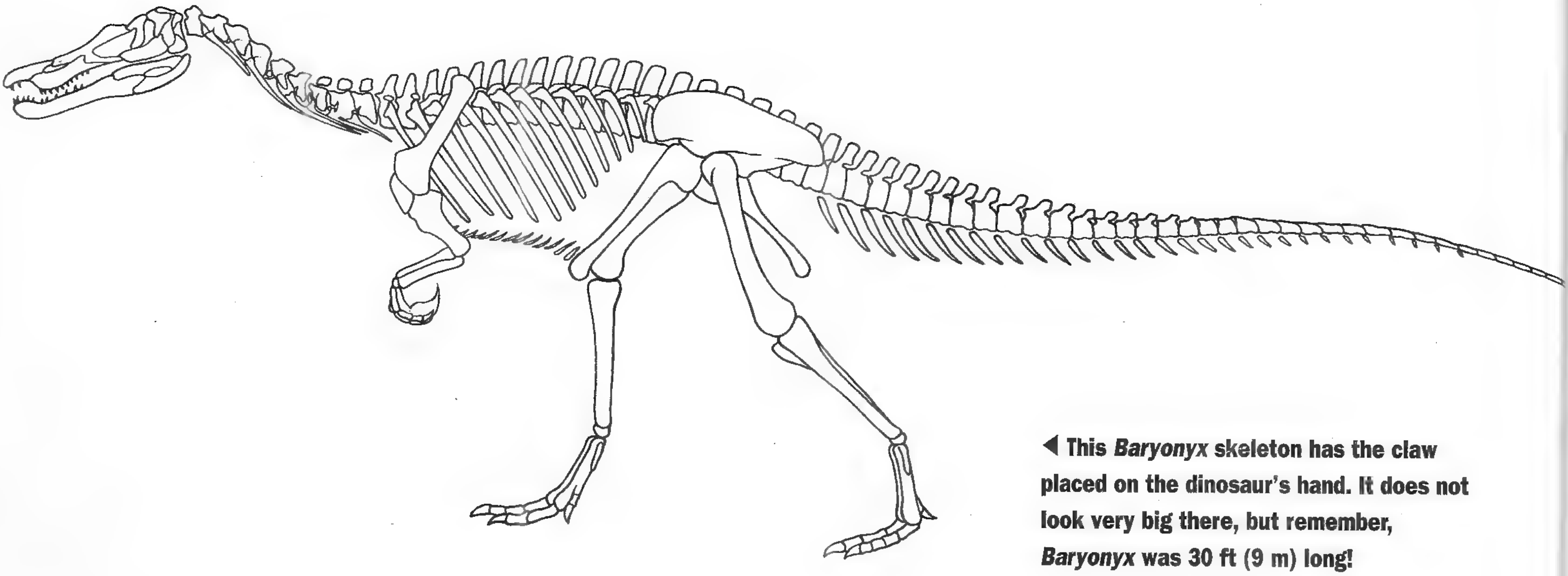
Why did *Baryonyx* have big claws if it was a scavenger? Simple, reply the second group of scientists. *Baryonyx* probably used its claws to tear open the dead body on which it fed.

The real *Baryonyx*

Did *Baryonyx* hunt for fish, or scavenge for left-overs? Probably both possibilities are right. Scientists are always seeking evidence to support their ideas. Sometimes their ideas are right. Sometimes they discover something new.



▲ **Did *Baryonyx* go fishing like modern grizzly bears? Some scientists say yes.**



◀ **This *Baryonyx* skeleton has the claw placed on the dinosaur's hand. It does not look very big there, but remember, *Baryonyx* was 30 ft (9 m) long!**

Baryonyx was too large to live entirely as a scavenger. It certainly could not get by just on soft, gooey guts. However, neither could an animal as big as *Baryonyx* survive on a diet of fish alone.

Baryonyx probably ate a mixture of food. It would have scavenged when it got the chance, as do most meat-eating animals today. *Baryonyx* probably also fed on fish when they were plentiful.

Baryonyx the hunter

Baryonyx could probably have hunted and killed other dinosaurs too. *Baryonyx* lived on river floodplains and in lowlands. It shared its world with dinosaurs such as *Hylaeosaurus*, *Iguanodon*, and *Hypsilophodon*. *Baryonyx* may have fed on these plant-eating animals. Even with its small teeth and weak jaws, *Baryonyx* could probably have killed the youngest, oldest, and weakest of these dinosaurs.

Killer claws

Baryonyx's claws could have been weapons. They were probably big enough to wound or kill a dinosaur. If *Baryonyx* did use its claws as weapons, it means they almost definitely belonged on the dinosaur's hands. *Baryonyx* was too big to jump up and attack with its feet. Raptors such as *Deinonychus* and *Velociraptor* could attack with their feet, but they were smaller and lighter than *Baryonyx*.

CHECK THESE OUT!

Archosaurs, Cretaceous period, Crocodiles, *Deinonychus*, *Hypsilophodon*, *Iguanodon*, Saurischian dinosaurs, *Spinosaurus*, Theropods, Tetanurans, *Velociraptor*

DINOFACTS

Baryonyx

(BAH-ree-ON-iks)

NAME: *Baryonyx* means heavy claw
baros (heavy) + onux (claw)

FAMILY: Saurischian → Theropod → Tetanuran

SIZE: 30 ft (9 m) long; about 10 ft (3 m) high at the hip

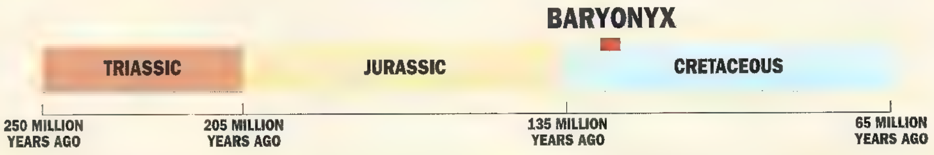
WEIGHT: 1–2 tons (0.9–1.8 tonnes)—about the same as 2–4 grizzly bears

FOOD: meat and maybe fish

HABITAT: lowlands, river floodplains

WHERE: remains found in southern England

WHEN: 125 million years ago in the Cretaceous period



Belemnoids

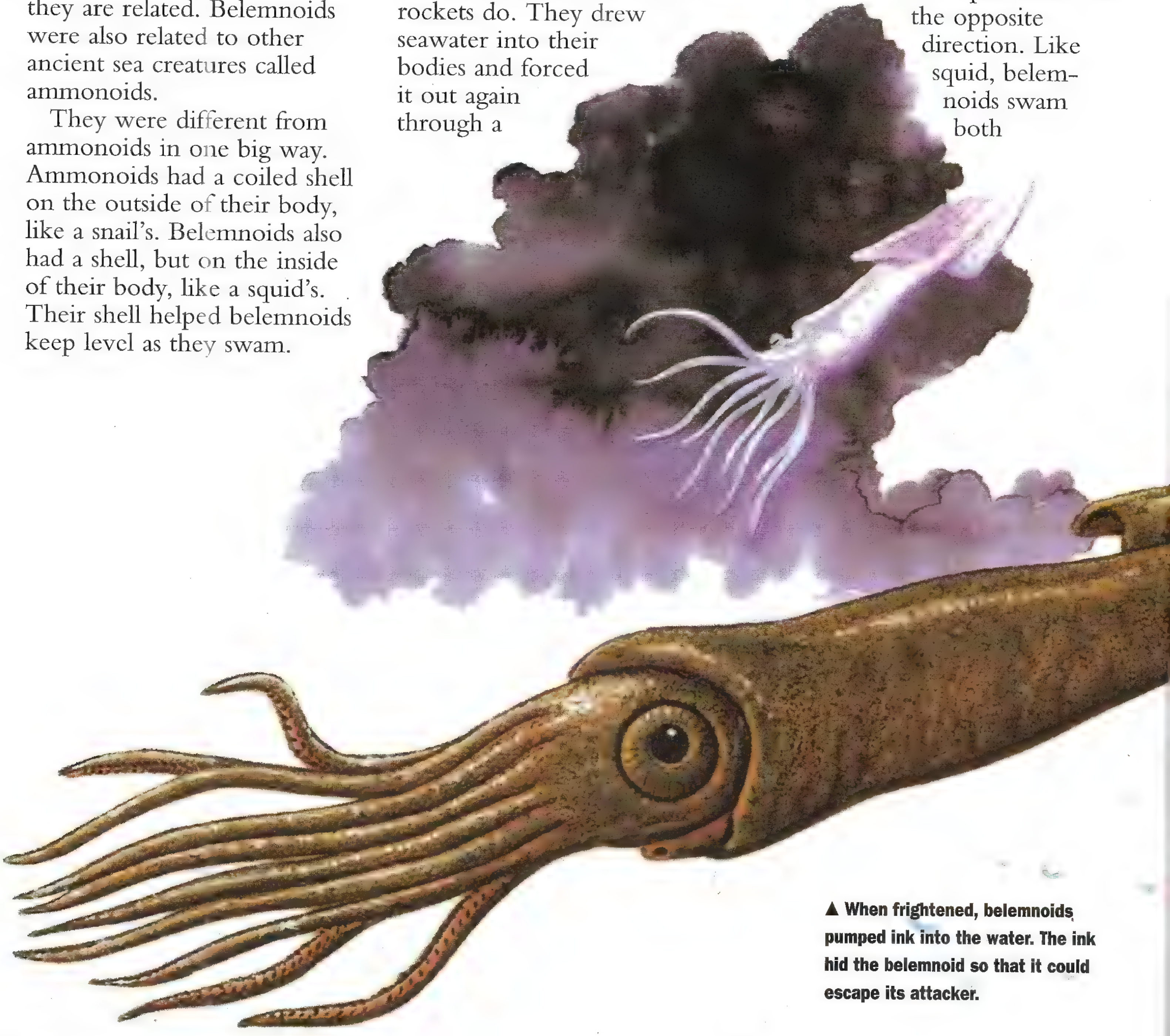
Belemnoids looked much like modern squid do today. There were many different kinds of belemnoids, and they were found in oceans throughout the world in the Jurassic and Cretaceous periods.

Belemnoids were sea creatures. They had long, soft bodies and many arms or tentacles, just like modern squid, to which they are related. Belemnoids were also related to other ancient sea creatures called ammonoids.

They were different from ammonoids in one big way. Ammonoids had a coiled shell on the outside of their body, like a snail's. Belemnoids also had a shell, but on the inside of their body, like a squid's. Their shell helped belemnoids keep level as they swam.

Undersea jets

Like squid, belemnoids were excellent swimmers. Belemnoids moved much as rockets do. They drew seawater into their bodies and forced it out again through a small hole called a siphon. By squirting the water in one direction, the belemnoid would push itself in the opposite direction. Like squid, belemnoids swam both



▲ When frightened, belemnoids pumped ink into the water. The ink hid the belemnoid so that it could escape its attacker.

HOW OLD ARE THEY?

Belemnoids lived in the sea, together with the great marine reptiles such as the ichthyosaurs, plesiosaurs, and mosasaurs. When one of these reptile skeletons is found, scientists want to know how old it is. Knowing a fossil's age helps to identify it. How can belemnoids help tell a fossil's age?

During the age of the dinosaurs, there were belemnoids of all kinds. During the Mesozoic Era, the belemnoids changed their forms quite quickly. If you can recognize the belemnoid species, you can date the rock in which it is found.

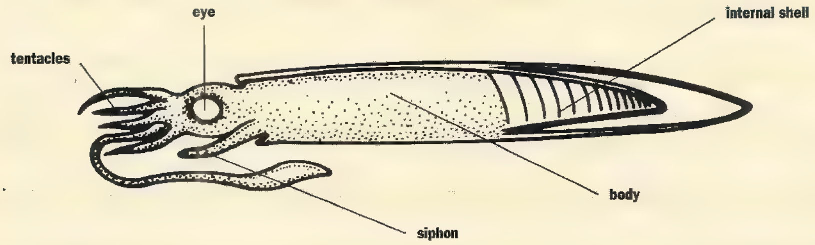
When a belemnoid died, usually the only part that remained was the internal shell. Scientists can tell the shells apart. They also know when different belemnoids lived.

So, when a new marine reptile skeleton is found, scientists look for a belemnoid fossil. They identify it and look up when it lived. The belemnoid's age will be the same as that of the unknown marine reptile.

FOSSIL FACTS

Belemnoids

(BELL-um-NOIDS)



▲ The picture shows the different parts of a belemnoid.

NAME: Belemnoid means like a dart belemnon (dart)

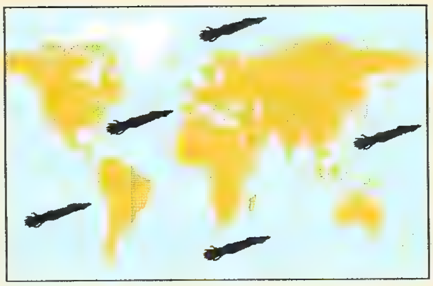
SIZE: from 4 in (10 cm) to over 6.5 ft (2 m) long

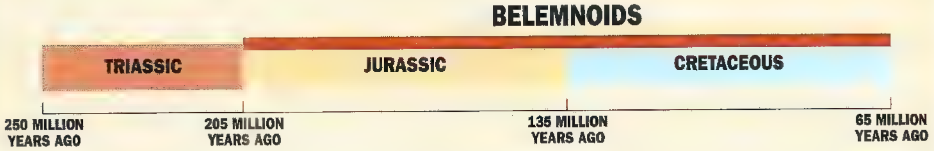
FOOD: slow-swimming animals and probably other belemnoids

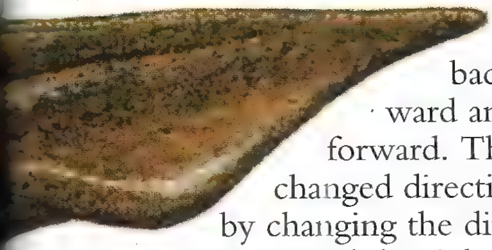
HABITAT: coastal waters

WHERE: remains found worldwide

WHEN: 205–65 million years ago in the Jurassic and the Cretaceous periods







backward and forward. They changed direction by changing the direction they pointed the siphon.

To swim quickly, belemnoids swam tail first. Their arrow-shaped body cut through the water as their tentacles trailed behind them. For this reason, they could probably swim faster than ammonoids.

How did belemnoids live?

Belemnoids lived mainly in coastal waters. They fed on slow-swimming animals hiding on the seafloor and may even have eaten one another!

Belemnoids used their tentacles to hunt. They could feel movement in the water when food swam nearby. They could see well, too. The position of their eyes meant they could see all around them. It would have been difficult for an animal to sneak up on a belemnoid. Even so, belemnoids were probably eaten by sea creatures such as sharks and ichthyosaurs.

CHECK THESE OUT!

Ammonoids; Coral reefs; Cretaceous period; Fossils; Ichthyosaurs; Jurassic period; Mosasaurs; Plesiosaurs, pliosaurs, and nothosaurs; Sharks

Birds

The dinosaurs died out 65 million years ago—or did they? The last dinosaurs are still with us today in the form of birds. Birds are living, breathing, theropod dinosaurs.

Birds are the only avialans still alive today. They share traits with the extinct avialans, but differ from them in some ways. For example, all living birds have feathers, wings, and beaks. Many avialans, like *Archaeopteryx*, also had feathers, wings, and beaks. However, most early avialans also had teeth; modern birds do not.

Dinosaurs among us

Because birds descended from dinosaurs, we say they are dinosaurs. Just like we say people are primates because, like apes, we descended from primates. From penguins to parakeets, birds are dinosaurs.

Like dinosaur, like bird

Today there are over 10,000 species of birds. This is more than 10 times the number of dinosaur species for which scientists have found remains.

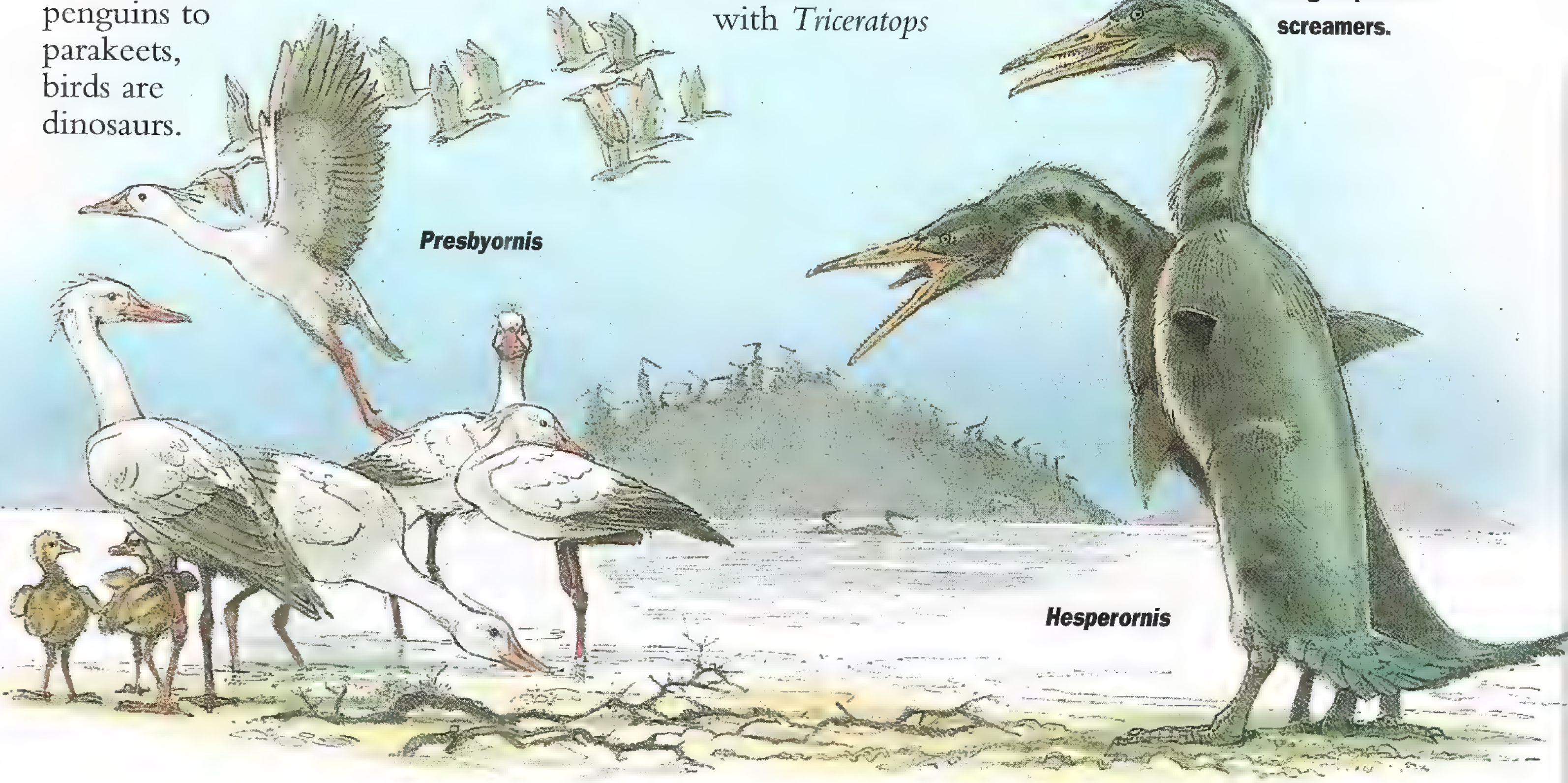
Scientists study birds to discover more about the behavior of these animals' extinct ancestors. Birds build and guard nests because their dinosaur ancestors did. Like today's birds, *Oviraptor* also rearranged and sat on its eggs while they developed.

The first birds

The earliest modern birds we have fossils of lived with *Triceratops* and *Tyrannosaurus* in the Late Cretaceous period. They were closely related to the grebes and loons of today. Grebes and loons paddle on lakes and dive for fish. Because of their small size and fragile skeletons, fossils of early birds are very rare.

After the Mesozoic Era (the age of dinosaurs), birds became more numerous and widespread. During the Cenozoic Era (the age of mammals, in

▼ *Hesperornis* was a toothy, fish-eating avialan that could not fly. *Presbyornis* was a true bird, it had no teeth. Its closest living relatives are the bird group called screamers.



BIRDS AND FEATHERS

Feathers are made from the same material as reptile scales. A typical bird feather has a strong rod in the middle, and thinner, hairy parts called barbs sprouting from it.

Feathers can be found on both birds and more primitive avialans. Although *Archaeopteryx* had feathers, it lived before the first true bird.

which we are living now), some strange birds appeared.

Diatryma was 6.5 ft (2 m) tall. It had a head the size of a horse's, and a toucan-sized, hooklike beak. It could not fly. It lived on the forest floors of North America and Europe 57–45 million years ago. So little is known about *Diatryma* that scientists cannot tell whether it ate meat or plants.

The phoruschracids ate meat. These fierce birds preyed on medium-sized mammals that looked like antelope. Only a few phoruschracids could fly.

Scientists found phoruschracid fossils in South America and Florida in rocks that are between 40 million and 2 million years old. South America was also home to a bird that was as big as a fighter plane. With its 25 ft (7.6 m) wingspan, *Argentavius* was the largest flying bird that ever lived. The heaviest bird of all was the flightless elephant bird, which weighed about 1,200 lbs (545 kg). It lived on the African island of Madagascar until about 10,000 years ago.

CHECK THESE OUT!

***Archaeopteryx*, Avialans, Eggs and babies, *Hesperornis*, Maniraptors, *Oviraptor*, Saurischian dinosaurs, Theropods**

DINOFACTS

Birds

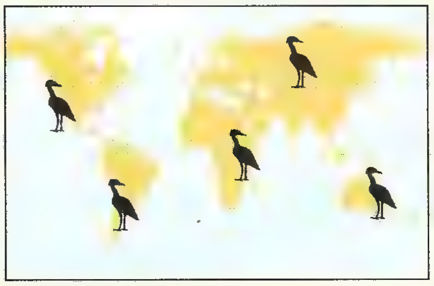
▶ The American bald eagle has a wingspan of 8 ft (2.4 m). The now extinct *Argentavius* had a wingspan of 25 ft (7.6 m).

SIZE: wide variation from the 1 in (2.54 cm) bee hummingbird of today to the 10 ft (3 m) elephant bird that died out 10,000 years ago

FOOD: varies from plants to other animals

HABITAT: wide variation from lakes to trees to mountains

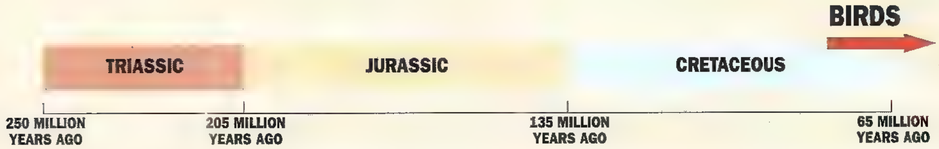
WHERE: worldwide



FAMILY:

- Saurischian
  - Theropod
    - Maniraptor
      - Avialan

WHEN: from 80 million years ago in the Late Cretaceous period to today



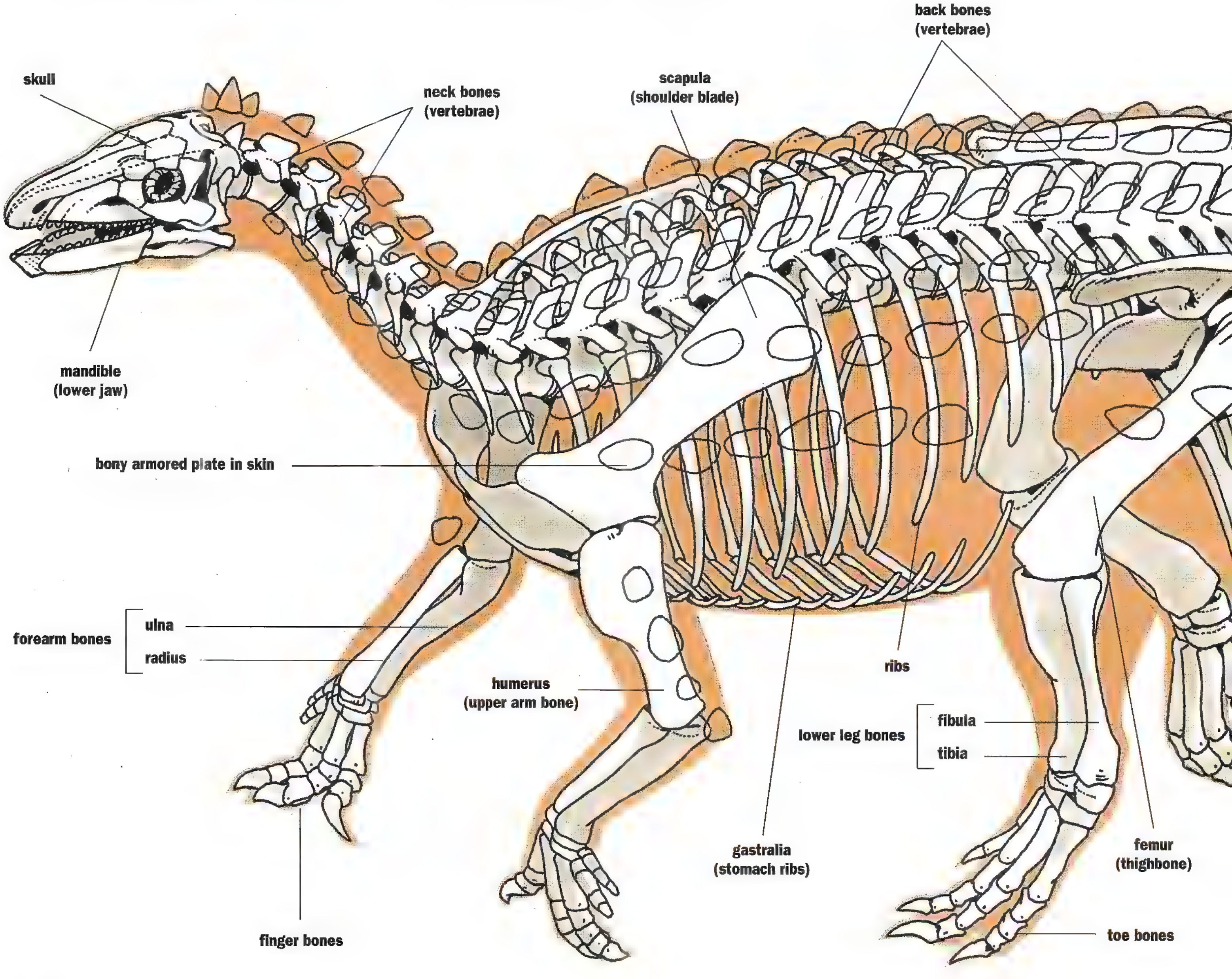
Bones

Bone is alive. It makes up our skeletons just as it did the dinosaurs' so many millions of years ago. Strong but light, bone allowed the dinosaurs to grow to huge sizes, yet still be able to move around.

Animals are divided into two large groups—those that have a bony skeleton inside them, and those that do not. Animals that do not have an internal skeleton are called invertebrates (animals without a backbone). Invertebrate animals include insects, spiders, shellfish, and octopuses.

Animals with a bony skeleton are called vertebrates (animals with a backbone). Vertebrates include mammals (for example, cats and dogs), birds, fishes, and reptiles.

Dinosaurs were reptiles. They had bony skeletons inside them. It is the remains of these skeletons that fossil-hunters find in ancient rocks.



Dinosaur bones

Dinosaurs could be huge animals, so did they have huge numbers of bones? No. Believe it or not, dinosaurs had about the same number of bones as reptiles do today. Like modern reptiles, some dinosaurs had stomach ribs, or gastralia.

Dinosaur bones were even in the same positions as modern reptile bones. So scientists label dinosaur bones with the same names they use for modern bones, including our own.

Remember, though, that scientists rarely find a complete dinosaur skeleton. Dinosaurs may have had some bones scientists do not know about yet.

What's in a bone?

Dinosaur bone was the same as modern bone. Bone is made up of hundreds and hundreds of thin threads covered with short, hard crystals. The crystals, which are made from the mineral apatite, make the bone hard.

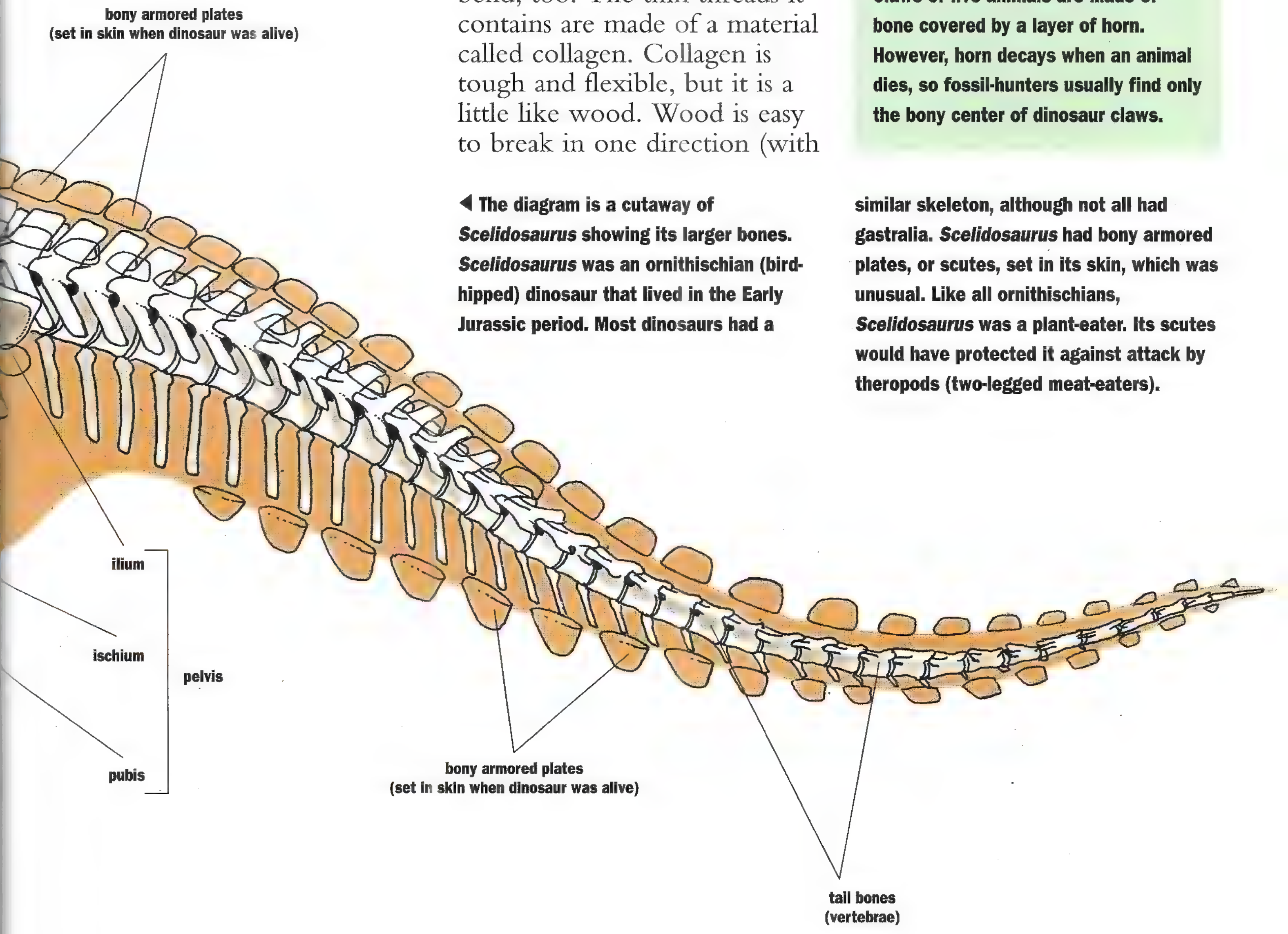
However, living bone can bend, too. The thin threads it contains are made of a material called collagen. Collagen is tough and flexible, but it is a little like wood. Wood is easy to break in one direction (with

TEETH AND CLAWS

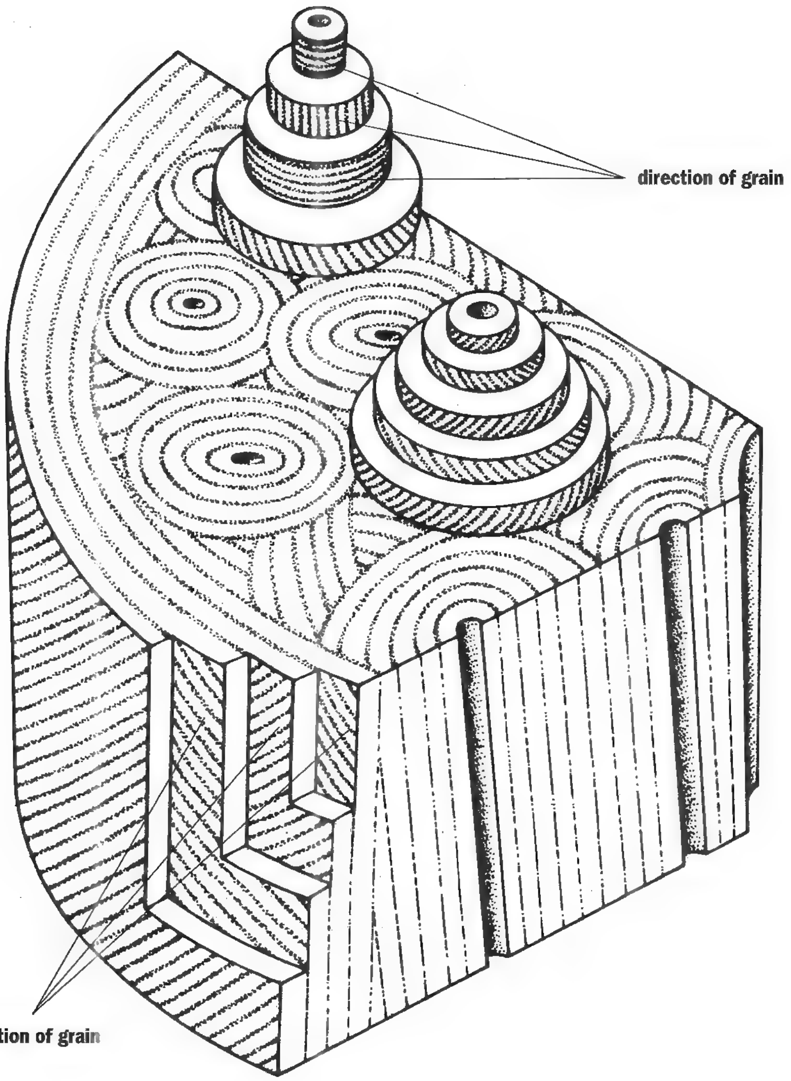
Besides bones, scientists often find dinosaur teeth. Like bones, teeth are mostly hard and fossilize well.

Teeth are made of a number of layers. At the center is the pulp, a soft layer of blood vessels and nerves. The pulp is covered by a thick layer of dentine, a live, bonelike substance. The dentine is protected in turn by a shell of a tough material called enamel, which is mostly apatite. Only the dentine and enamel layers fossilize. The pulp decays and is lost.

Scientists also find dinosaur claws. Claws of live animals are made of bone covered by a layer of horn. However, horn decays when an animal dies, so fossil-hunters usually find only the bony center of dinosaur claws.



◀ The diagram is a cutaway of *Scelidosaurus* showing its larger bones. *Scelidosaurus* was an ornithischian (bird-hipped) dinosaur that lived in the Early Jurassic period. Most dinosaurs had a similar skeleton, although not all had gastralia. *Scelidosaurus* had bony armored plates, or scutes, set in its skin, which was unusual. Like all ornithischians, *Scelidosaurus* was a plant-eater. Its scutes would have protected it against attack by theropods (two-legged meat-eaters).



◀ **Bone is made of layer on layer of collagen. The shading shows the grain. Notice that each layer's grain runs in a different direction from that of the layer before.**

the grain) but hard to break in the other direction (across the grain). Collagen is similar. If all the layers of collagen had a grain running in the same direction, the bone would be strong only in that direction. So each layer of collagen has its grain running in the opposite direction from the layer before it.

Woven through the bone are big and small blood vessels, and these carry blood to the bone. A bone is a living thing. It needs blood to keep it healthy, to help it grow, and to help it mend if it is damaged. The more active an animal is, the more blood it needs in its bones. A few scientists believe they can tell how active a type of dinosaur was by counting how many blood vessels there were in a piece of bone.

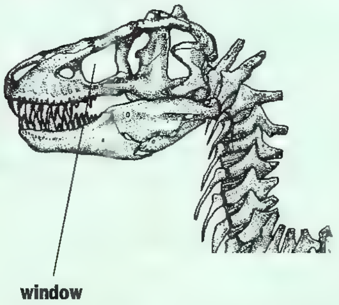
Test of strength

Because of its makeup, bone is a very strong material. It can be stretched and squashed and still not be damaged. This is good because it has to put up with a lot. Think of a *Tyrannosaurus* standing still. In

LOSING WEIGHT

Because dinosaurs were so big, their muscles needed a little extra help to move them around. They got this help from their skeletons, which developed holes, or windows, to make them lighter. Windows did not make the skeletons weak, though, because the bone surrounding the holes was still strong. Many dinosaurs, such as *Tyrannosaurus*, had windows in their skull (1), while some ceratopsians (horned dinosaurs), like *Anchiceratops*, had holes in their frill (2). *Apatosaurus* had windows in its neck bones (3).

1



Side view of *Tyrannosaurus* skull

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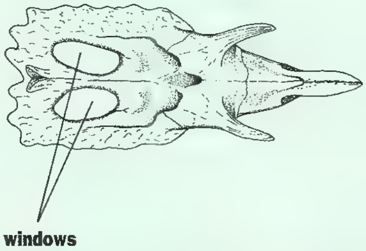

Top view of *Anchiceratops* skull and frill

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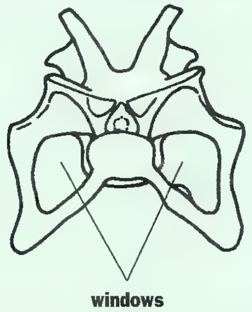


Front view of *Apatosaurus* neck bone

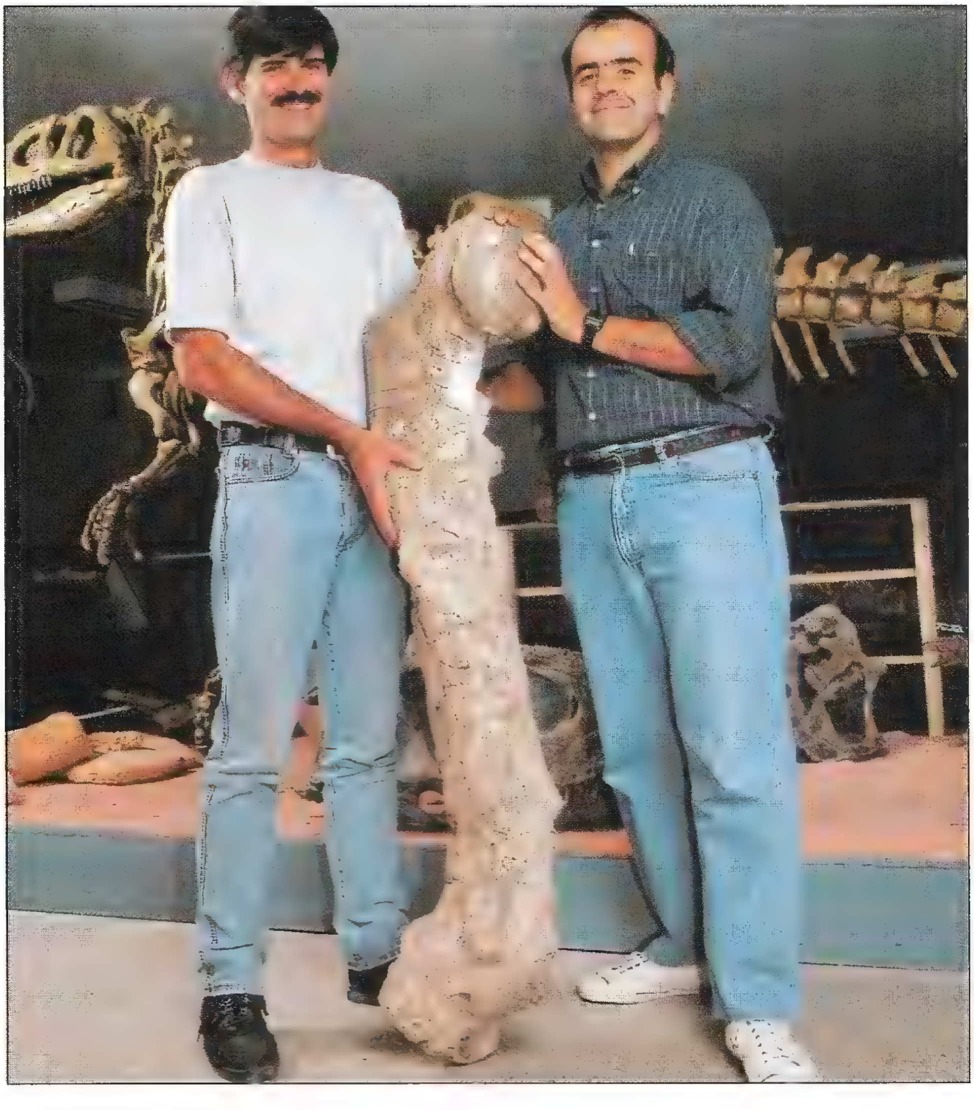
this position, its foot bones would need to hold about 7 tons (6.3 tonnes) of dinosaur. That's as heavy as two North American bison on top of an African elephant.

Now think of a *Tyrannosaurus* running. Because of the movement, the strain on the bones goes up. The pressure on the foot bones of a running *Tyrannosaurus* would have been enormous!

BONEFACTS

- **Bones first evolved during the Cambrian period (550–505 million years ago).**
- **Bones can be tiny, less than a millimeter across. They can also be huge like the 6.5 ft (2 m) thighbone (femur) of a large sauropod.**
- **The upper arm bone (humerus) of a sauropod, a human, and *Archaeopteryx* look fairly similar, but are very different in size.**
- **Most vertebrate animals (animals with an internal skeleton) have about 200–250 bones. Except for its tail, a big sauropod did not have any more bones than a modern shrew, even though the dinosaur was hundreds of thousands of times bigger. Big sauropods had over 50 bones (vertebrae) in their tails.**
- **The skull of a vertebrate animal has almost 50 bones.**

▼ Dinosaur bones could be huge. Argentinian paleontologists Rodolfo Coria (left) and Leonardo Salgado hold the thigh bone of *Giganotosaurus*, one of the largest meat-eating dinosaurs ever.



The miracle of bone

If bones are so strong, shouldn't they also be very heavy? No. Only the bone walls are made of compact bone (collagen and apatite). The center of the bone is filled with a lighter, spongy material called bone marrow. Some dinosaur bones were hollow. If bones were solid, the big sauropods could never have walked. *Brachiosaurus* had thighbones over 6.5 ft (2 m) long. Imagine the weight if these and all its other bones had been solid! That is the amazing thing about bone. Even though it is light and flexible, it could hold up a 30-ton (27.2-tonne) dinosaur.

CHECK THESE OUT!

Anchiceratops*, *Apatosaurus*, *Archaeopteryx*, Birds, *Brachiosaurus*, Fish, Geological time, *Giganotosaurus*, Insects, Mammals, Shellfish, *Tyrannosaurus

Bony Fish

Bony fish evolved over 400 million years ago. They were the ancestors of the dinosaurs, and filled the seas, rivers, and lakes.

Most fish today are bony fish. As their name suggests, bony fish have bony skeletons. This makes them different from sharks, which have skeletons made out of a flexible material called cartilage.

Before the first dinosaur walked the earth, bony fish had already evolved into the two main groups that exist today. Scientists call these two groups lobe fins and ray fins. Lobe fins have fins with fleshy lumps, or lobes, in them. Ray fins have slim fins with stiff, bony struts in them. Ray fins came in all shapes and sizes, as they do today. Lobe fins were less varied.

Mesozoic ray fins

Lepidotes and *Semionotus* were Mesozoic ray fins that were plentiful from the Late Triassic period to the Early Cretaceous period. *Lepidotes* and *Semionotus* were freshwater fish that also looked a bit like modern bony fish. They ate water plants and lived among the sandbars in the many lakes of what is now the eastern United States.

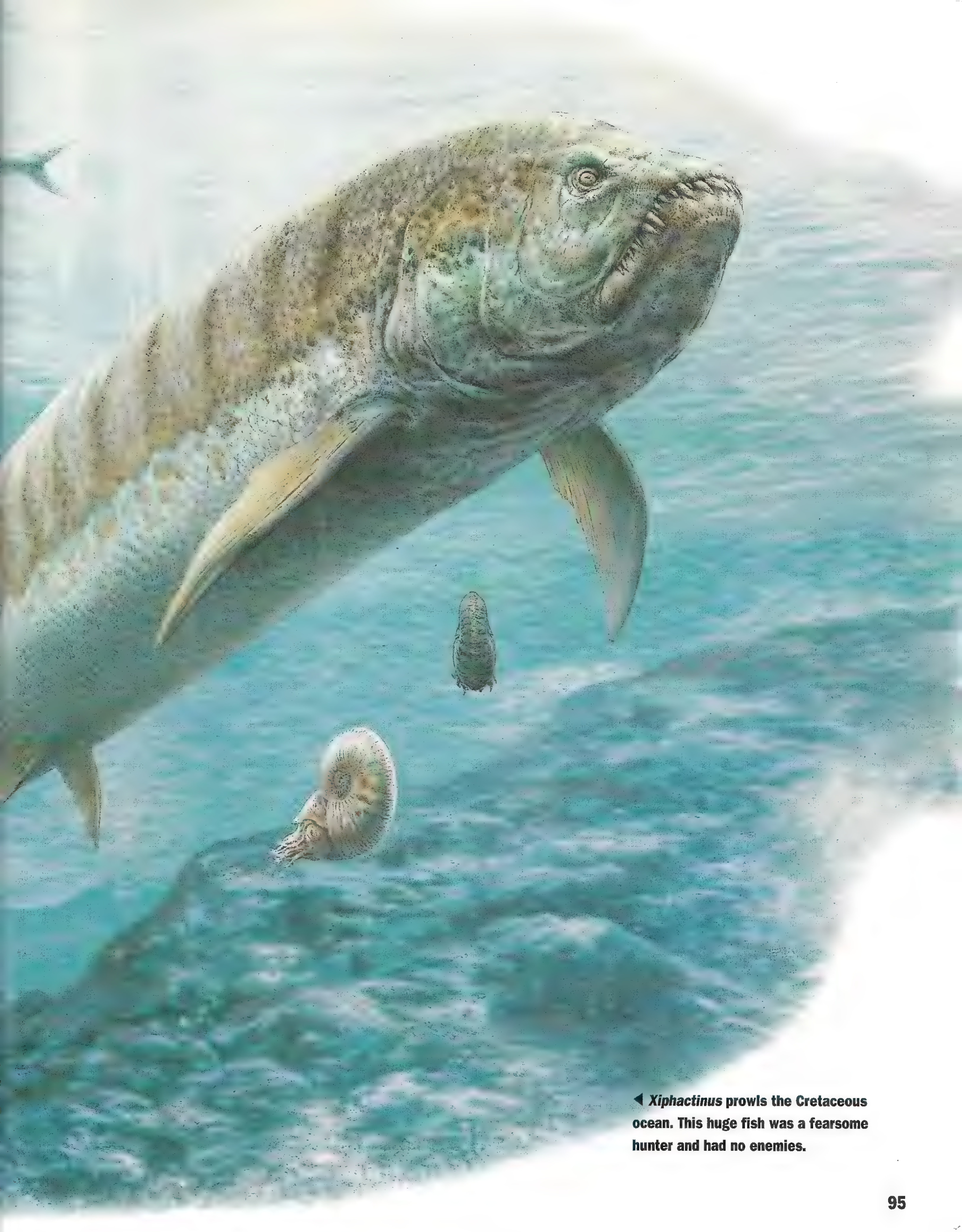
At one time, all the *Lepidotes* and *Semionotus* probably lived in one huge lake. The water level may have dropped so that the lake became divided into many smaller lakes. Once separated, the fish would have evolved slightly differently, making many different species. Each lake had its own slightly different species of *Lepidotes* and *Semionotus*.

This is happening again today in Africa's Rift Valley. One big lake has dried up into many smaller lakes. Of course, the African lakes are not filled with *Lepidotes* or *Semionotus*. The Rift Valley fish are called cichlids.

Holosteans and teleosts

Lepidotes and *Semionotus* belonged to a group of ray fins called holosteans. *Lepidotes* and *Semionotus* were the ancestors of modern paddlefish. However, most of today's ray fins are not holosteans but belong to a later group known as the teleosts.

Teleosts evolved about 175 million years ago in the Jurassic. The earliest teleosts were small and all lived in the



◀ *Xiphactinus* prowls the Cretaceous ocean. This huge fish was a fearsome hunter and had no enemies.

THE LIVING FOSSIL

Coelacanths are bizarre fish. They have two pairs of muscly, fleshy fins beneath their body. Why would a fish have such strong fins? Believe it or not, coelacanths use their fins as legs to waddle across the ocean floor. About 370 million years ago, relatives of the coelacanths walked on land to become the first four-legged amphibians.

Scientists thought that coelacanths had been extinct for 100 million years. Then, in 1938, fishermen hauled up a strange fish from the deep waters off South Africa. It was a coelacanth. Since then fishermen have caught many more of these bizarre fish.

The modern coelacanth is about 5 ft (1.5 m) long and weighs about 100 lb (45 kg). It is so similar to its relatives from the age of the dinosaurs that scientists call the fish a living fossil.

sea. They fed on plankton—swarms of tiny water plants and animals. The fish took in a mouthful of water as they swam along and filtered the food from it. Then they let the water out again before taking in the next mouthful.

By the Cretaceous period, meat-eating teleosts evolved. Among these hunting fish was a giant called *Xiphactinus*, which grew to 16 ft (5 m) long. It lived in the seas that covered North America.

Scientists know *Xiphactinus* fed on fish because they have found remains with fish skeletons where the stomach would have been. One *Xiphactinus* had fed on 10 different species of fish, and another had eaten a fish one third its own length!

Gentle giant

Another teleost, *Leedsichthys,* was more than twice as big as *Xiphactinus*. It was about 40 ft (12.2 m) long—the size of a humpback whale. *Leedsichthys* was probably a gentle giant. It was not a hunter but fed on plankton like early teleosts did.

Lobe fins

Lobe fins were far less varied than ray fins. There were only two main types in the age of

▶ The Australian lungfish is one of six modern lungfish species. Lungfish live in burrows in the dry season. Scientists have found lungfish burrows in Mesozoic rocks.

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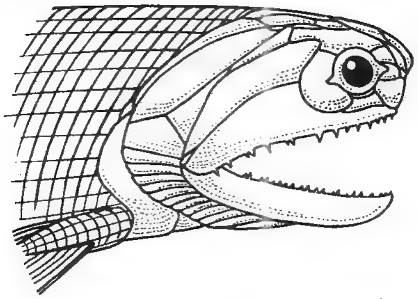

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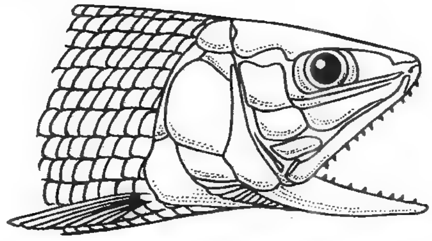

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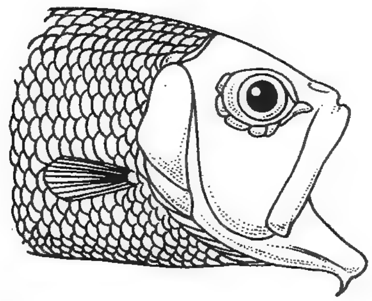


the dinosaurs—the lungfish and the coelacanths. Lungfish and coelacanths still exist today, and look and live much like their Mesozoic ancestors.

Lungfish were and are amazing fish. They have gills to breathe underwater, but they also have lungs so they can breathe in the open air. The pools they live in dry out in hot weather. The fish live in burrows in the mud and breathe fresh air until the next time it rains heavily.

Lungfish lived in fresh water and ate plants and water creatures, including large fish. Coelacanths fed on fish, too. The largest coelacanth ever found was the 10 ft (3 m) long *Mawsonia*. *Mawsonia* was one of the biggest hunters in the seas around Gondwanaland, one of the Jurassic supercontinents.

Bony fish did not become extinct with the dinosaurs at the end of the Cretaceous period. All of the species that lived in the Mesozoic Era have gradually died. Their descendants are the bony fish of today. From the tiny guppy to the 6 ft (1.8 m) barracuda, teleosts make up most of today's fish.

▲ Bony fish jaws evolved in the age of the dinosaurs. Early fish jaws (1) opened and shut like ours. Holosteans (2), like *Lepidotes* and *Semionotus*, could open their mouth a little wider. Teleosts (3), like *Xiphactinus*, *Leedsichthys*, and most modern bony fish, could push their jaws right forward so they formed a tube. A flexible mouth allowed teleosts to feed in different ways. Some species use their mouth to nibble at coral. Others use it to suck in prey.

CHECK THESE OUT!

Coral reefs, Cretaceous period, Fish, Jurassic period, Sharks, Shellfish, Triassic period

FOSSIL FACTS

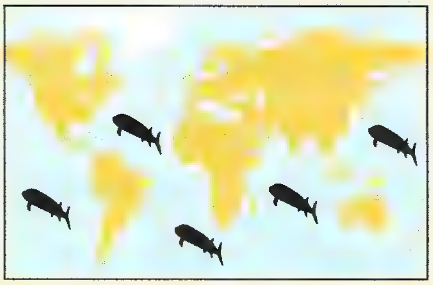
Bony Fish

SIZE: wide variation from 0.3 in (7.5 mm) to 40 ft (12.2 m) long

FOOD: meat (other fish, aquatic reptiles, land animals in the water), plants, remains of dead creatures

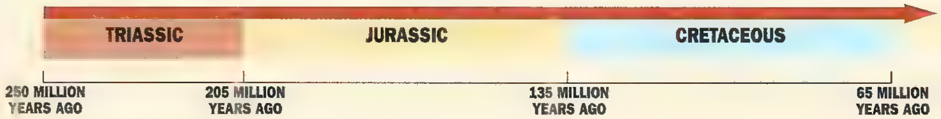
HABITAT: salt water and fresh water (seas and oceans, rivers and lakes)

WHERE: remains found worldwide



WHEN: from 410–360 million years ago in the Late Devonian period to today

BONY FISH



Brachiosaurus

Brachiosaurus was a huge, plant-eating sauropod, with a long neck and tail. It lived in the Jurassic period in what is now North America and Africa. Like all real giants, *Brachiosaurus* was rare.

Believe it or not, scientists once thought *Brachiosaurus* lived mostly in water. Why? Because it was so big.

Scientists thought that *Brachiosaurus* was too heavy to move on land. So, they argued, it must have lived in water. The water would have supported the dinosaur's huge weight. *Brachiosaurus* could then have moved around easily.

Prehistoric snorkeling?

Brachiosaurus had a very long neck. It had huge nostrils near the top of its head. Could the dinosaur have breathed through these nostrils while it walked along the beds of lakes and rivers? Could the nostrils have worked like the snorkels people use when they swim underwater?

Until the 1950s, some scientists thought so. They believed *Brachiosaurus* walked underwater holding the top of its head just above the surface. This way, the dinosaur could breathe as it searched for food.

Scientists now know that *Brachiosaurus* could not have snorkeled. If the dinosaur had walked underwater with its neck held straight up, its body would have been in water almost 40 ft (12.2 m) deep. *Brachiosaurus* had a big, strong chest. Even so, the crushing pressure of the water would have been too great for the dinosaur. *Brachiosaurus* would not have had the strength to inflate its lungs. It could not have breathed.

How did it move?

Brachiosaurus was a land animal. It was one of the largest land animals that ever lived. How did the dinosaur survive when it was so huge? How could it carry such a lot of weight around?

Brachiosaurus was not as heavy as its size first suggested. Like many other sauropods, its backbones had holes in them. The bones were still strong, but they were also very light.

Even so, *Brachiosaurus* could not run fast. It could not run like a galloping horse—that is with all four feet off the ground at one time. If the dinosaur had tried, the weight of its enormous body would have broken its legs.

However, *Brachiosaurus* may have been able to trot like an elephant. Even that would have made the ground shake!

How did *Brachiosaurus* live?

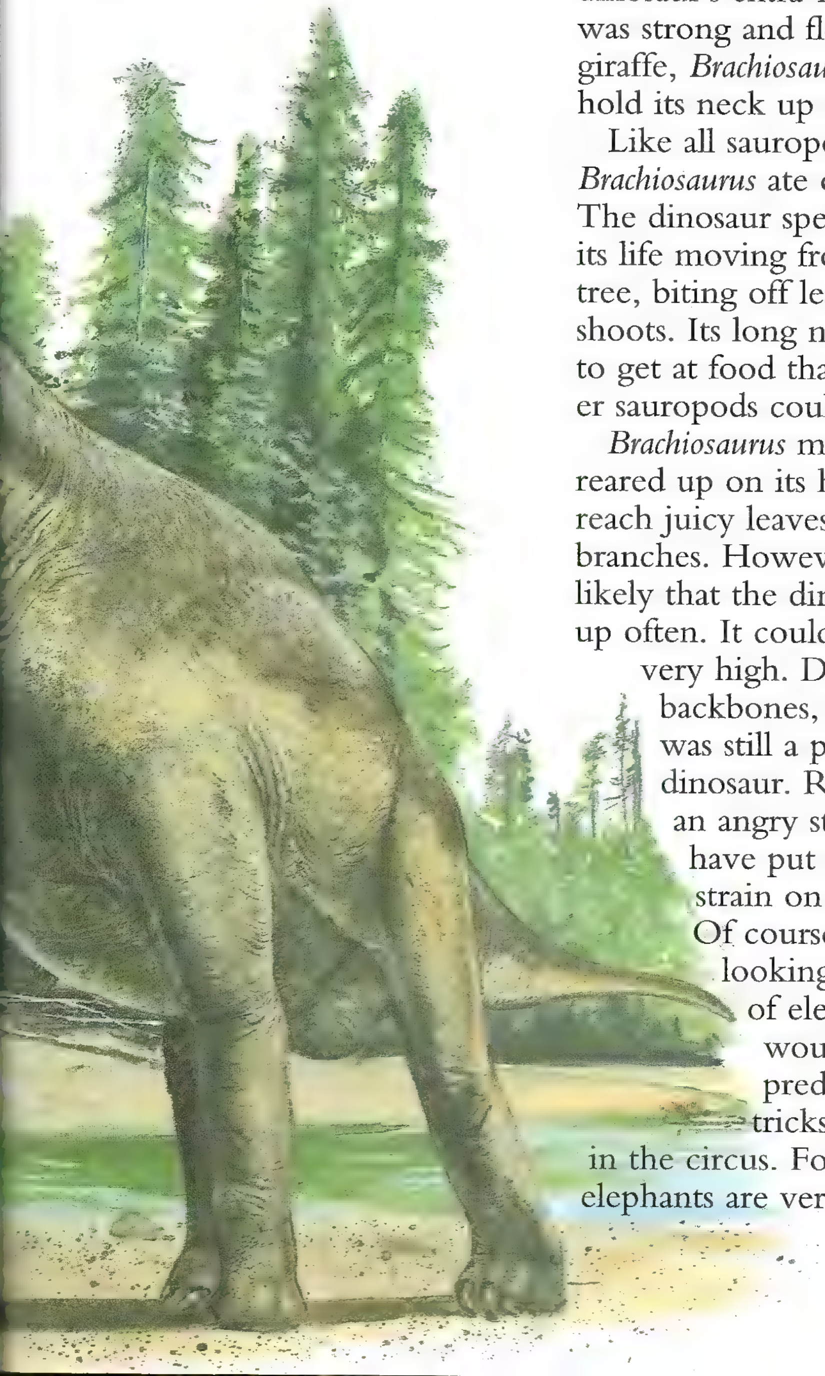
Brachiosaurus behaved like an

▶ ***Brachiosaurus* got its name, arm lizard, because its forelegs were longer than its hind legs.**

AN ESCALATOR NECK

There is no doubt that the neck of *Brachiosaurus* was designed to be held straight upward. However, animals whose necks are raised high above their hearts like this are faced with a problem. How do they get blood from their heart all the way up their neck to their brain? Sauropods had deep chests. These contained a powerful heart to pump blood around their massive bodies. Their chests also contained large lungs to make sure there was plenty of oxygen in the blood to help their muscles work properly.

However, sauropod hearts probably needed a little extra help to deliver the blood to their faraway brain. Giraffes have specialized muscles and valves that pump their blood all the way up their neck to their brain. Scientists think sauropods like *Brachiosaurus* probably had similar muscle pumps.



enormous giraffe. The dinosaur's extra-long neck was strong and flexible. Like a giraffe, *Brachiosaurus* could also hold its neck up straight.

Like all sauropods, *Brachiosaurus* ate only plants. The dinosaur spent most of its life moving from tree to tree, biting off leaves and shoots. Its long neck allowed it to get at food that other, smaller sauropods could not reach.

Brachiosaurus may even have reared up on its hind legs to reach juicy leaves in the high branches. However, it is not likely that the dinosaur reared up often. It could already reach very high. Despite its light backbones, *Brachiosaurus* was still a pretty heavy dinosaur. Rearing up like an angry stallion would have put an enormous strain on its legs. Of course, just by looking at the bones of elephants, it would be hard to predict all the tricks they can do in the circus. For example, elephants are very heavy animals, yet they can still stand on their hind legs. Actually, it was easier for *Brachiosaurus* to rear up than it is for an elephant. *Brachiosaurus* carried more weight on its hind legs than on its forelegs. When it reared, its back end acted like the heavy end of a seesaw. Elephants are the opposite. They carry more weight on their forelegs. Elephants have to heave all that weight into the air to rear up onto their hind legs.

The Colorado *Brachiosaurus*

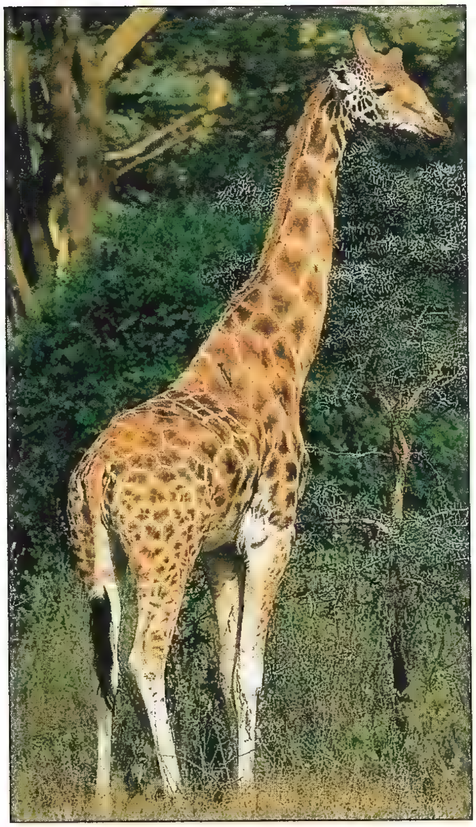
The American fossil-hunter Elmer G. Riggs was the first to discover *Brachiosaurus*. He found the remains of the dinosaur near Fruita, Colorado, in rocks called the Morrison Formation. *Brachiosaurus* was an unusual sauropod, Riggs realized. Its forelegs were much longer than its hind legs. Therefore, the dinosaur's back must have sloped from the front down to its rear.

A dinosaur family tree

Scientists like to put dinosaurs into family trees. It helps them figure out who evolved from whom. Plus, dinosaur cousins probably acted alike.

Brachiosaurus had two cousins, *Diplodocus* and *Camarasaurus*. Who was *Brachiosaurus* more like?

Diplodocus had a long skull like a giraffe. However, unlike a giraffe, *Diplodocus* had long hind legs and short forelegs. Its back sloped down from rear to front. When *Diplodocus* walked, it held its neck down low.



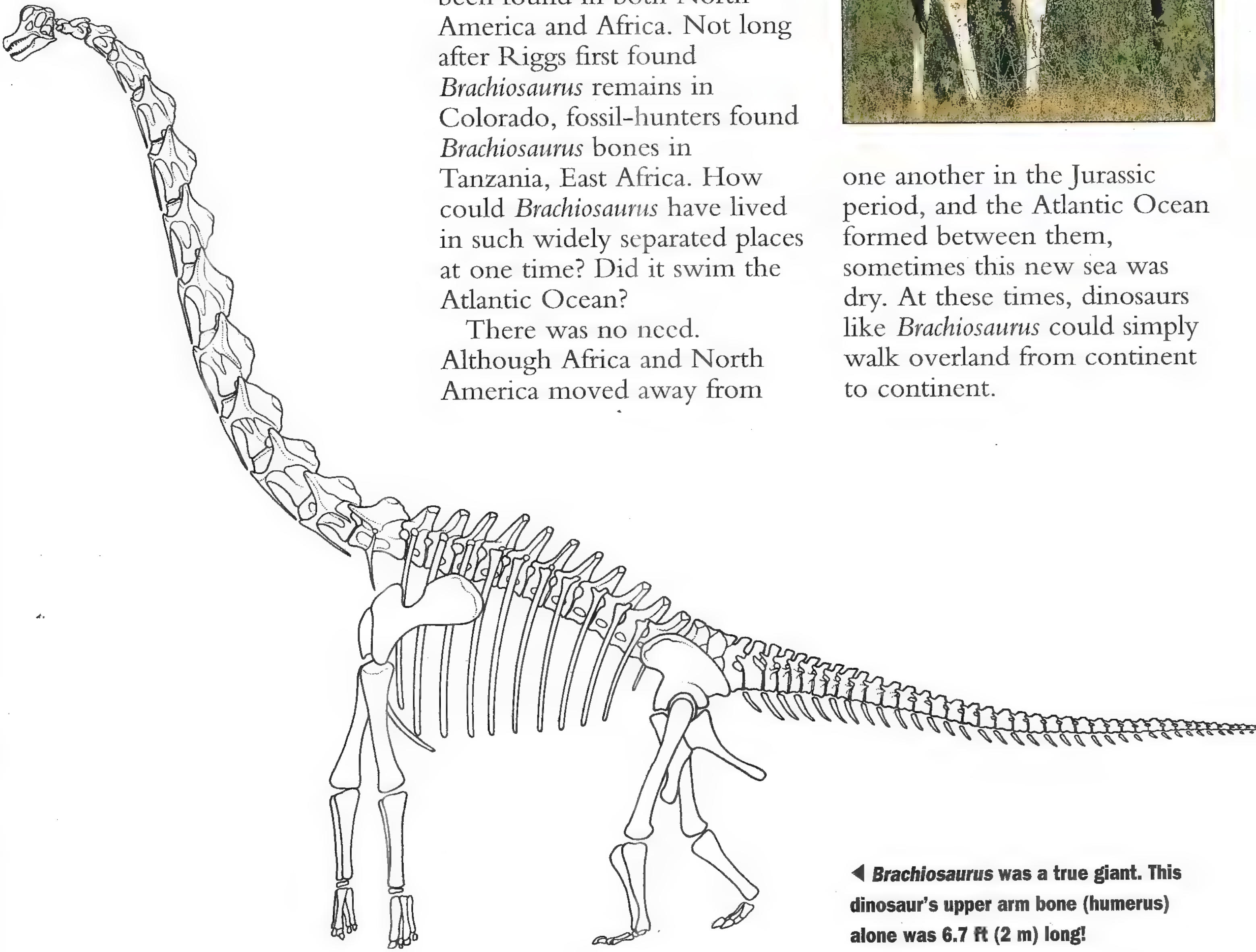
▶ A giraffe wanders among trees in Africa. Giraffes are more lightly built than *Brachiosaurus* was. However, they are very similar in shape.

Camarasaurus was different. Its hind legs and forelegs were about the same length, so its back was almost straight. Also, *Brachiosaurus*'s skull was a lot like *Camarasaurus*'s. So *Brachiosaurus* was more closely related to *Camarasaurus*.

Intercontinental dinosaur?

Brachiosaurus is one of many dinosaurs whose remains have been found in both North America and Africa. Not long after Riggs first found *Brachiosaurus* remains in Colorado, fossil-hunters found *Brachiosaurus* bones in Tanzania, East Africa. How could *Brachiosaurus* have lived in such widely separated places at one time? Did it swim the Atlantic Ocean?

There was no need. Although Africa and North America moved away from one another in the Jurassic period, and the Atlantic Ocean formed between them, sometimes this new sea was dry. At these times, dinosaurs like *Brachiosaurus* could simply walk overland from continent to continent.



◀ *Brachiosaurus* was a true giant. This dinosaur's upper arm bone (humerus) alone was 6.7 ft (2 m) long!

Different species?

The African *Brachiosaurus* was slightly different from the American *Brachiosaurus*. The African dinosaur was more lightly built. It also had longer forelegs and a shorter body. So how could both these animals be the same kind of dinosaur?

The answer is that they were probably different species of *Brachiosaurus*—like the long-eared African elephant and the short-eared Asian elephant are two different species of elephants. Perhaps even more species of *Brachiosaurus* lived in Jurassic times. We just haven't found them yet.

Ultrasauros

In 1979, the American paleontologist Jim Jensen was digging in Colorado. He found the remains of a huge sauropod. Some scientists thought this dinosaur might have been even bigger than *Brachiosaurus*. Perhaps, they thought, it could have been more than 100 ft (30 m) long and 70 tons (63.5 tonnes) in weight. They called it Ultrasauros.

After more study, though, they discovered that it was really no bigger than the biggest *Brachiosaurus*. They decided that the bones must belong to *Brachiosaurus*. The name Ultrasauros is now as extinct as the sauropods.

CHECK THESE OUT!

***Apatosaurus*, Bones, *Camarasaurus*, Continental drift, *Diplodocus*, Jurassic period, Rocks, Saurischian dinosaurs, Sauropodomorph dinosaurs, Sauropods**

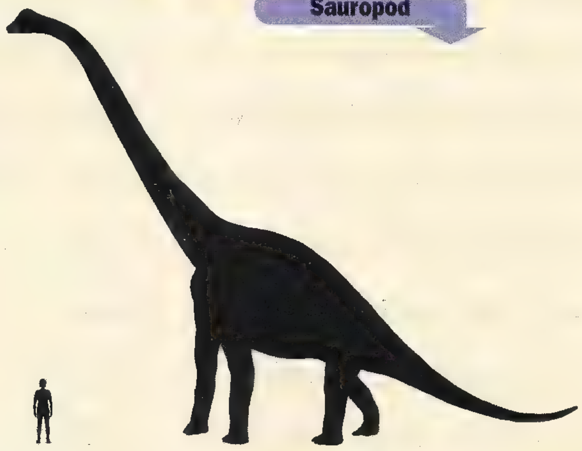
DINOFACTS

Brachiosaurus

(BRAAK-ee-o-SORE-us)

NAME: *Brachiosaurus* means arm lizard
brachium (arm) + sauros (lizard)

FAMILY:
- **Saurischian**
  - **Sauropodomorph**
    - **Sauropod**

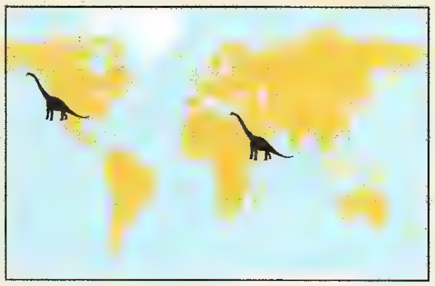


SIZE: 75–80 ft (22.9–24.4 m) long; 40–50 ft (12.2–15.2 m) to the top of its head

WEIGHT: 30–35 tons (27.2–31.8 tonnes)—about the same as 6–7 African elephants

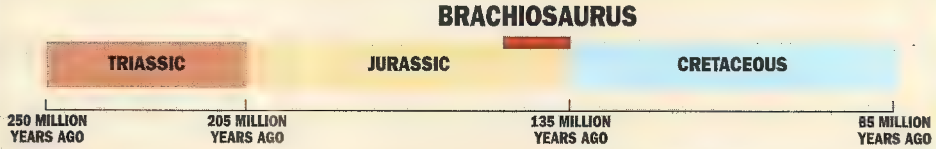
FOOD: plants

HABITAT: lowland open forest



WHERE: remains found in Colorado in the United States and Tanzania in East Africa

WHEN: 150–135 million years ago in the Jurassic period



Brachyceratops

***Brachyceratops* belonged to a group of dinosaurs called the ceratopsians, or horned dinosaurs. It was first discovered by the American paleontologist Charles Whitney Gilmore.**

Brachyceratops was a fairly small horned dinosaur. It had short horns over its eyes, and a longer nose horn that gently curved back. *Brachyceratops* looked a little like *Centrosaurus* (which was once thought to be yet another dinosaur—*Monoclonius*). This similarity caused confusion when fossil-hunters discovered the first *Brachyceratops* remains.

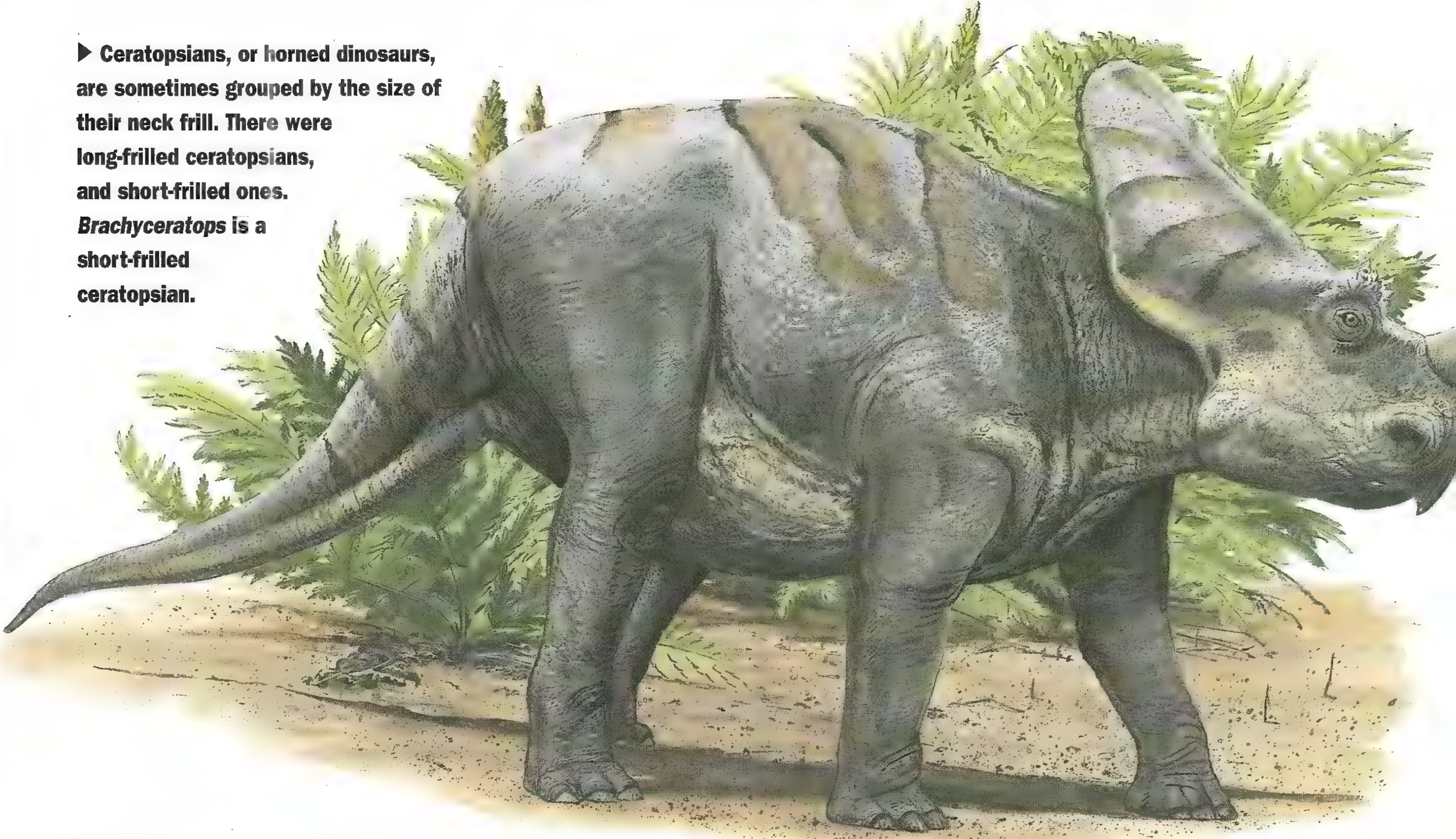
Mistaken identity

The first *Brachyceratops* skeletons were found in Montana in 1913. Fossil-hunters discovered five ceratopsian skeletons next to one another. Because the skeletons were small for a ceratopsian, the scientists guessed they were the remains of young dinosaurs. Their horns were in the same place as those of *Centrosaurus*, so the scientists decided the skeletons must have been *Centrosaurus* young.

Right horns, wrong frill

Twenty years later, fossil-hunters dug up a larger ceratopsian skeleton near where the five smaller ones had been. It had similar horns to the smaller skeletons, but the shape of its bony neck frill was different.

Most ceratopsians had these neck frills, and scientists knew they changed shape as a dinosaur got older. However, when the scientists checked this frill against that of *Centrosaurus*, it did not match. That meant the skeletons that had been found in Montana were not *Centrosaurus*. They belonged to a new dinosaur. The scientists named it *Brachyceratops*.



▶ Ceratopsians, or horned dinosaurs, are sometimes grouped by the size of their neck frill. There were long-frilled ceratopsians, and short-frilled ones. *Brachyceratops* is a short-frilled ceratopsian.

AN ANCIENT JIGSAW PUZZLE

The first *Brachyceratops* skull was found shattered in many pieces among the rocks of Montana. These fragmented bits had to be carefully removed from the rocks. Later, scientists pieced them together in a laboratory.

Experts who rebuild new-found dinosaurs use their knowledge of similar dinosaurs to put the pieces together correctly. They need a lot of skill and patience. Much has been learned about the evolution of dinosaurs through the work of these experts.

How did this dinosaur live?

Like all ceratopsians, *Brachyceratops* ate plants. It lived in herds and may have been hunted by a meat-eating dinosaur called *Aublysodon*, a medium-sized relative of the fearsome giant *Tyrannosaurus*.

Dinosaur family

Why would one large skeleton and five small skeletons be in a single place? The answer is a sad one. Scientists think the six dinosaurs may have been a family—perhaps a mother and her young. Somehow, they all died together about 75 million years ago.

CHECK THESE OUT!

Centrosaurus*, Ceratopsians, Cretaceous period, Ornithischian dinosaurs, Theropods, *Tyrannosaurus

DINOFACTS

Brachyceratops

(BRAAK-ee-SAIR-uh-tops)

NAME: *Brachyceratops* means short horned-face
brachy (short) + keratos (horned) + ops (face)

FAMILY: **Ornithischian** → **Ceratopsian**

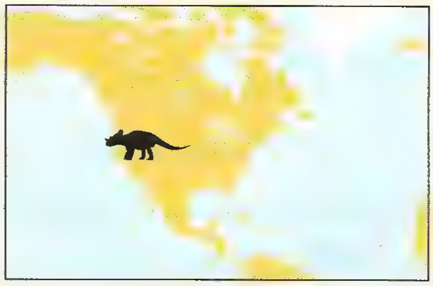
SIZE: 13 ft (4 m) long; 4.5 ft (1.4 m) high at the hip

WEIGHT: 1–3 tons (0.9–2.7 tonnes)—about the same as 1–2 white rhinoceroses

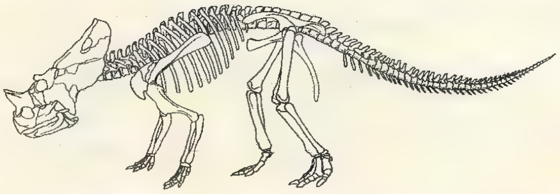
FOOD: plants

HABITAT: lowlands, river floodplains, and near deltas

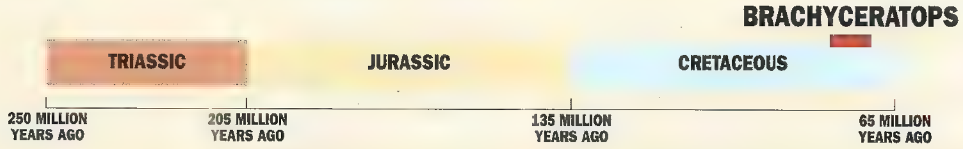
WHERE: remains found in Montana



▼ Not one of the six *Brachyceratops* skeletons was complete. By using all six sets of remains, scientists pieced together a whole skeleton.



WHEN: 80–70 million years ago in the Cretaceous period



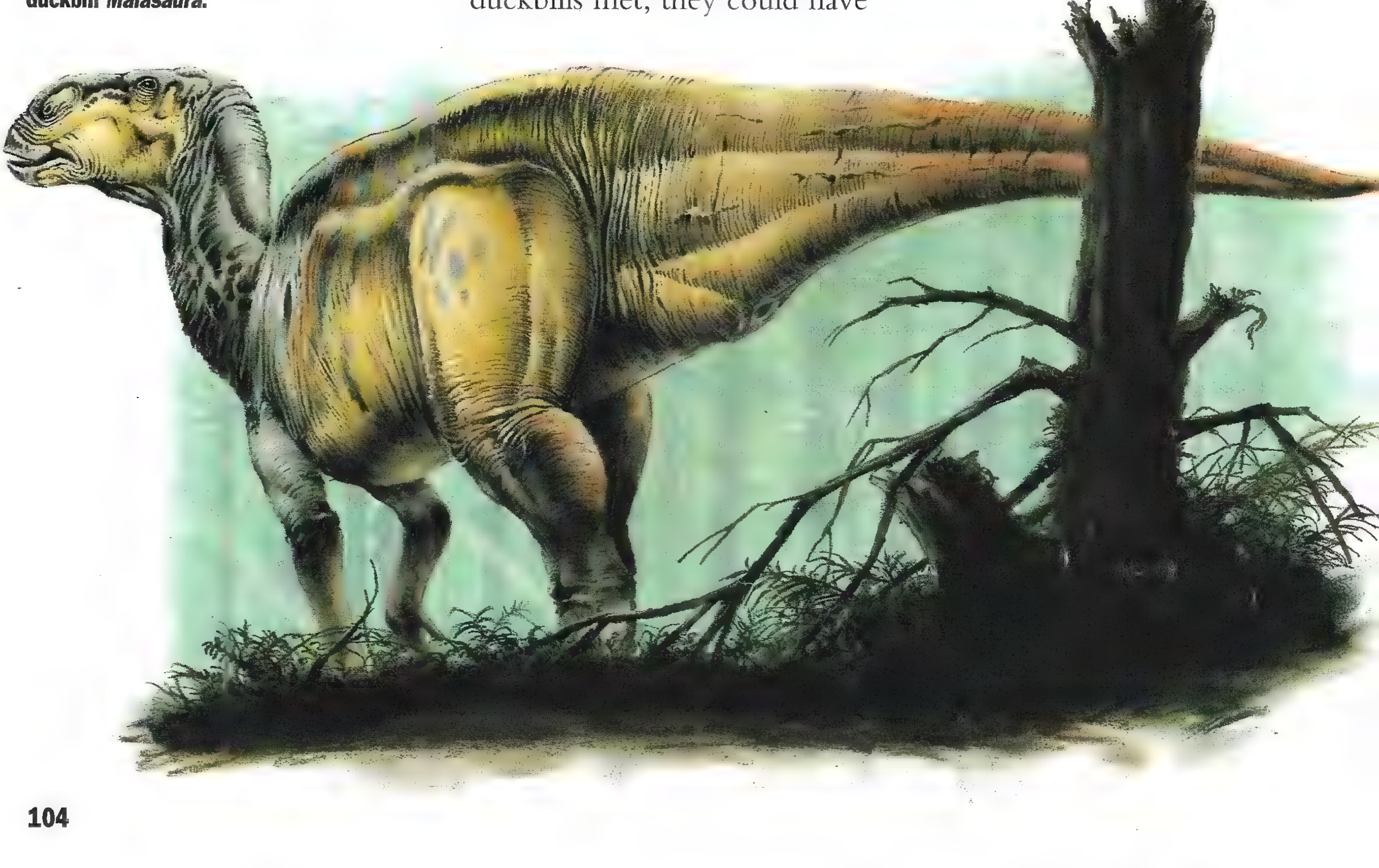
Brachylophosaurus

Brachylophosaurus was a hadrosaur, or duckbill dinosaur. Fossil-hunters first found remains of this dinosaur in Alberta, Canada, in 1936. It took until 1953 for scientists to work out exactly what it was.

Brachylophosaurus was a fairly late duckbill dinosaur, but it seems to have looked more like an early one. Many of the later duckbills had amazing crests on their head. *Parasaurolophus* had a huge, curved crest. *Corythosaurus* had an upright, bony disk.

Not *Brachylophosaurus*, though. It did have a crest, but it was just a narrow bar of bone bulging above the nostrils.

▼ *Brachylophosaurus* appeared in the Late Cretaceous period. The closest relative of *Brachylophosaurus* was the duckbill *Maiasaura*.



Hadrosaur relations

Both *Corythosaurus* and *Parasaurolophus* had hollow crests. Hadrosaurs with hollow crests are called lambeosaurines. However, *Brachylophosaurus*'s crest was solid, like that of its close relative *Kritosaurus*. These solid-crested duckbill dinosaurs are called hadrosaurines.

Dinosaur ID?

Why did duckbills have a crest anyway? Well, *Parasaurolophus* had a different shaped crest than *Corythosaurus* or *Brachylophosaurus*. When two duckbills met, they could have looked at one another's crest to make sure they were both the same duckbill type.

It is even possible that crests were a different shape in male and female duckbills. Some modern animals have clear differences that help males and females tell each other apart. Think of birds. Males of many species have brightly colored feathers. Females are often duller in color. Perhaps male and female *Brachylophosaurus* could tell each other apart by the shape of their crest.

HEAD-TO-HEAD

Were duckbill crests only for identification? Scientists think perhaps not. Male *Brachylophosaurus* probably fought one another to find out who was the strongest. During these fights, they butted one another with the flat crests on their heads.

***Brachylophosaurus*'s crest would have been a good weapon. It would also have been a good shield to stop the dinosaurs from getting injured.**

How did it live?

Like all duckbill dinosaurs, *Brachylophosaurus* ate plants. Its mouth contained hundreds of teeth to grind up the abundant Cretaceous vegetation.

Brachylophosaurus also had fairly long arms for a hadrosaur. Scientists think it may have spent more time on all fours than other duckbills.

Brachylophosaurus shared its world with tyrannosaurids, including *Albertosaurus* and *Daspletosaurus*. These dinosaurs probably hunted duckbills. *Brachylophosaurus* could not fight them; it ran away.

Duckbills had powerful tails and paddlelike hands. They were probably good swimmers. To escape from a meat-eater, *Brachylopohosaurus* probably rushed into a lake or a nearby swamp.

CHECK THESE OUT!

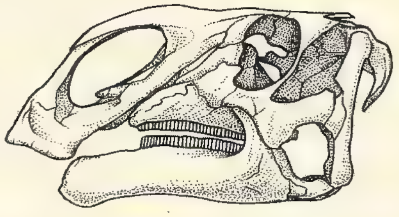
Albertosaurus*, *Corythosaurus*, Cretaceous period, *Daspletosaurus*, Hadrosaurs, *Kritosaurus*, *Maiasaura*, Ornithischian dinosaurs, Ornithopods, *Parasaurolophus*, *Tyrannosaurus

DINOFACTS

Brachylophosaurus

(BRAAK-ee-LO-fuh-SORE-us)

▶ Fossil-hunters found a very good skull of *Brachylophosaurus*. The large hole at the front of the skull is one of the dinosaur's huge nostrils.

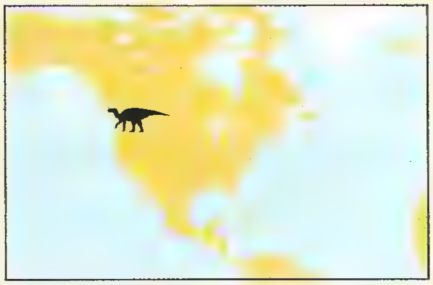


NAME: ***Brachylophosaurus*** **means short-crested lizard**
brachy (short) + lophos (crest) + sauros (lizard)

FAMILY: **Ornithischian**
Ornithopod
Hadrosaur

SIZE: 23 ft (7 m) long; 5 ft (1.5 m) high at the hip

WEIGHT: 1–3 tons (0.9–2.7 tonnes)—about the same as 1–3 North American bison

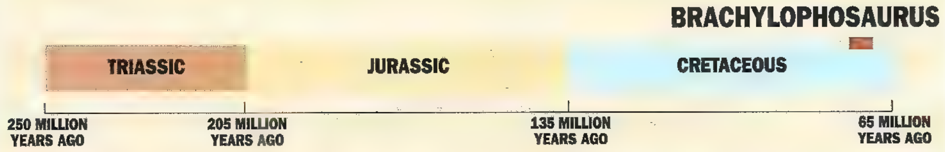


FOOD: plants

HABITAT: lowlands, coastal plains, and near river deltas

WHERE: remains found in Montana in the United States, and Alberta in Canada

WHEN: 75 million years ago in the Cretaceous period



Camarasaurus

Camarasaurus was a sauropod, a large plant-eating dinosaur with a long neck and tail. At the time it was alive, *Camarasaurus* was the most common sauropod in what is now North America.

Because *Camarasaurus* was so common, fossil-hunters have found many of this dinosaur's bones. Many of the skeletons were almost complete. These remains have enabled experts to learn a lot about this dinosaur.

The first bones discovered belonged to young animals. To begin with, scientists did not know that the bones they had found belonged to young dinosaurs. They guessed that *Camarasaurus* was a small sauropod. How did they discover their mistake?

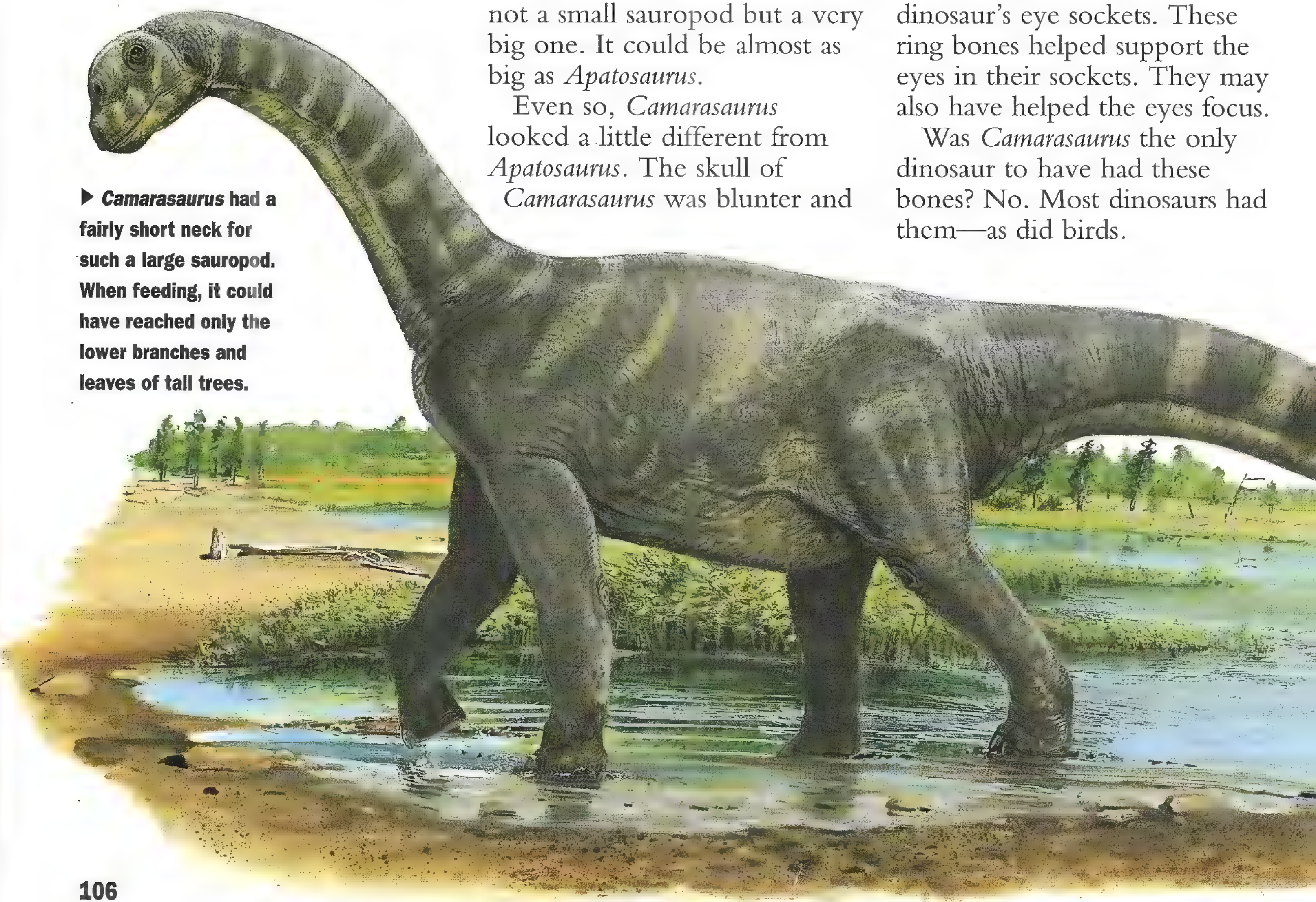
What happened was that fossil-hunters dug up bones that were similar in shape to the early finds—but much larger. The experts realized that these were the bones of a fully grown *Camarasaurus*. It was clear that *Camarasaurus* was not a small sauropod but a very big one. It could be almost as big as *Apatosaurus*.

Even so, *Camarasaurus* looked a little different from *Apatosaurus*. The skull of *Camarasaurus* was blunter and less slender. Where *Apatosaurus* had teeth only at the front of its mouth, *Camarasaurus* had teeth along the sides of its jaws, too. *Camarasaurus* also had a fairly short neck, which made the animal look chunky.

Dinosaur eyes

Scientists studying one *Camarasaurus* skeleton made an amazing discovery. They found small ring bones in the dinosaur's eye sockets. These ring bones helped support the eyes in their sockets. They may also have helped the eyes focus.

Was *Camarasaurus* the only dinosaur to have had these bones? No. Most dinosaurs had them—as did birds.



▶ *Camarasaurus* had a fairly short neck for such a large sauropod. When feeding, it could have reached only the lower branches and leaves of tall trees.

THE BEST FIND

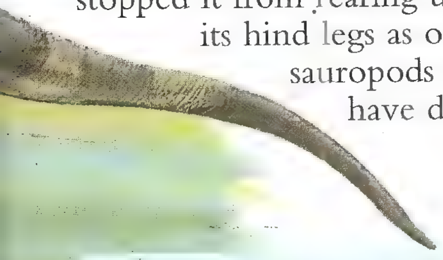
The most complete *Camarasaurus* skeleton found so far was discovered at Dinosaur National Monument, Utah, in 1922. It was the skeleton of a young animal, 17 ft (5.2 m) long. It is now in the Carnegie Museum, Pittsburgh.

When the fossil-hunters found the skeleton, it had a thin covering of carbon. Could this covering be what was left of the dinosaur's skin? Scientists believe so. It is rare to find the remains of dinosaur skin or flesh. The main reason is because soft tissues rot very quickly after death. Another reason is that, soon after an animal died, meat-eating dinosaurs usually ate soft tissues like the skin.

How did *Camarasaurus* live?

Camarasaurus was a plant-eater. It shared its home with other big sauropods, including *Apatosaurus*, *Diplodocus*, and *Barosaurus*. The plate-backed dinosaur *Stegosaurus* also lived alongside *Camarasaurus*.

Despite its huge size, meat-eating dinosaurs like *Allosaurus* may have hunted *Camarasaurus*. No one knows how *Camarasaurus* defended itself. It would have been too big to run away. Its tail would have stopped it from rearing up on its hind legs as other sauropods may have done.



CHECK THESE OUT!

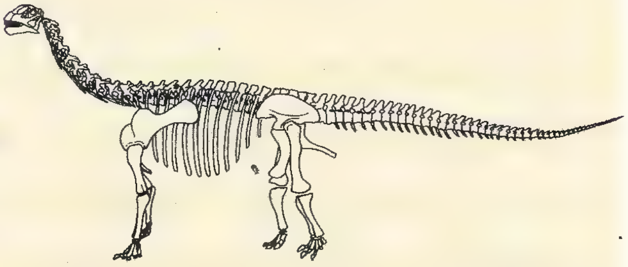
Apatosaurus*, Jurassic period, Saurischian dinosaurs, Sauropodomorph dinosaurs, Sauropods, *Stegosaurus

DINOFACTS

Camarasaurus

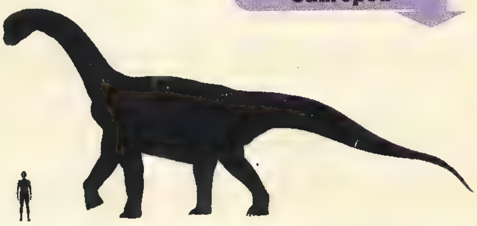
(KAM-uh-ruh-SORE-us)

▶ Unlike *Apatosaurus*, *Camarasaurus* had no whiplash tip to its tail. So it probably could not use its tail to defend itself as *Apatosaurus* may have done.



NAME: *Camarasaurus* means chambered lizard
camera (chamber) + sauros (lizard)

FAMILY:
Saurischian
Sauropodomorph
Sauropod



SIZE: 60 ft (18.3 m) long; 15 ft (4.6 m) high at the hip

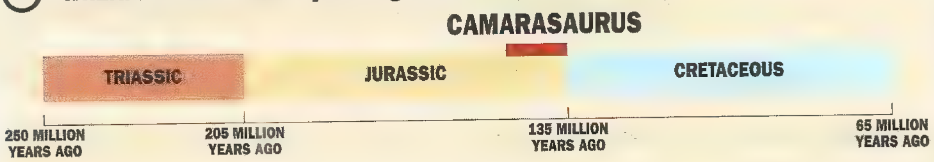
WEIGHT: 20–25 tons (18–22.5 tonnes)—about the same as 4–5 African elephants

FOOD: plants

HABITAT: lowlands and floodplains

WHERE: remains found in Colorado, Utah, and Wyoming in the United States, and Portugal in Europe

WHEN: 150–135 million years ago in the Jurassic period



Camptosaurus

Camptosaurus lived in North America and England. No one has ever found a whole *Camptosaurus* skeleton. However, scientists have pieced together enough bits to guess what it was like.

Scientists have found *Camptosaurus* bones in both North America and England. How could one dinosaur live on two continents?

It didn't. In the Jurassic period, North America and Europe were joined as part of one big continent that scientists call Laurasia.

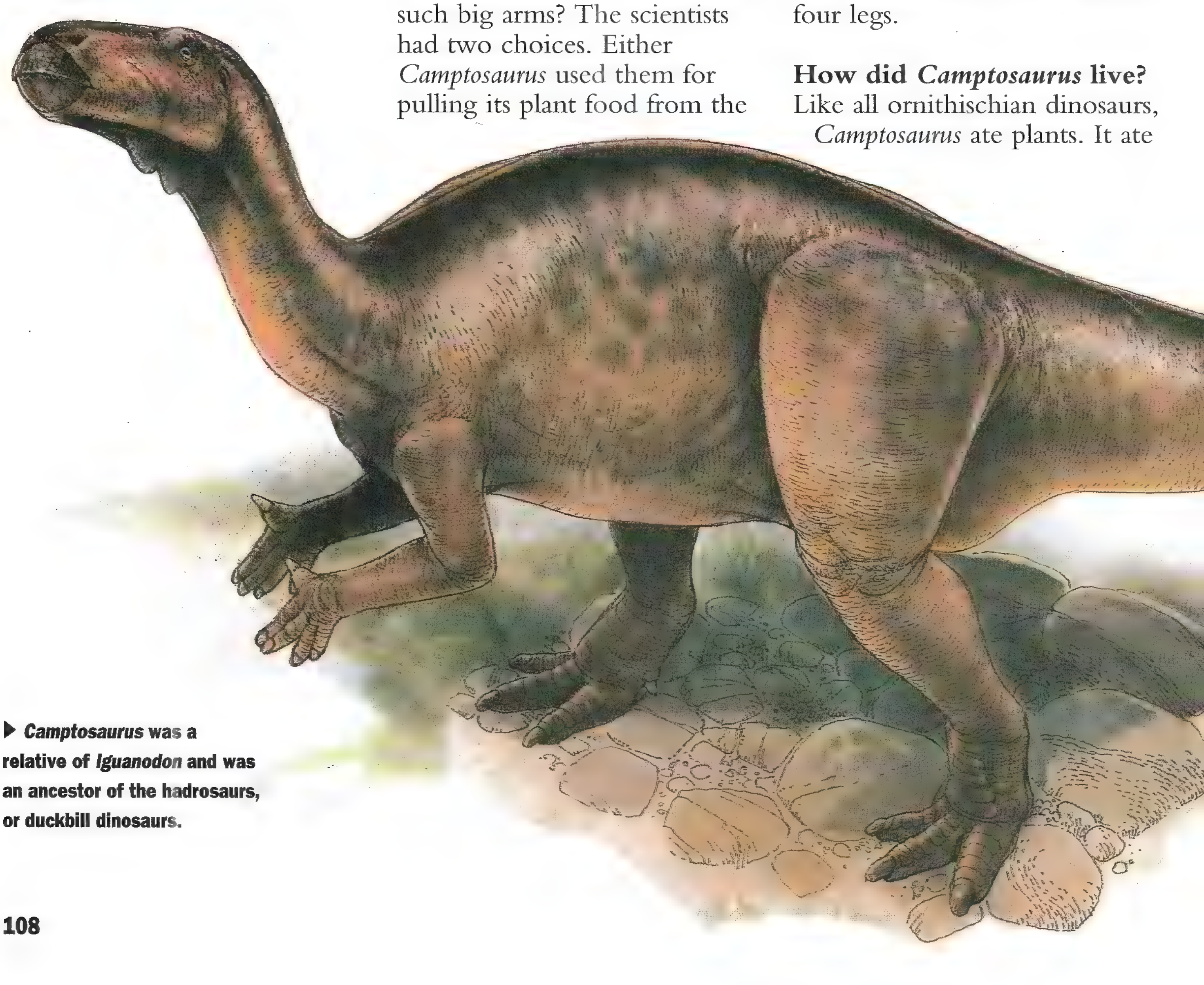
Two legs, or four?

Scientists used to believe that *Camptosaurus* walked on its hind legs like *Tyrannosaurus*. Today they think it walked on all fours. Why did they change their minds? Because of the dinosaur's arms. They were smaller than its hind limbs but still pretty strong.

Why did *Camptosaurus* have such big arms? The scientists had two choices. Either *Camptosaurus* used them for pulling its plant food from the trees, or it walked on them. One look at the dinosaur's hands told the scientists which was the right answer. The hands of *Camptosaurus* were better suited for walking than for grasping. In particular, *Camptosaurus* had small hooves on its fingers, instead of claws. So scientists decided that *Camptosaurus* usually walked on four legs.

How did *Camptosaurus* live?

Like all ornithischian dinosaurs, *Camptosaurus* ate plants. It ate



▶ ***Camptosaurus* was a relative of *Iguanodon* and was an ancestor of the hadrosaurs, or duckbill dinosaurs.**

everything from the ground up to about 6 ft (1.8 m).

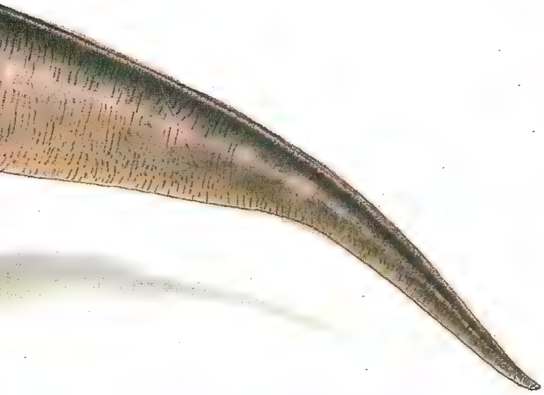
Camptosaurus lived alongside the meat-eating dinosaur *Allosaurus*. How did *Camptosaurus* defend itself? Some relatives of *Camptosaurus*, such as *Iguanodon*, had long, sharp, thumb claws to use as weapons. *Camptosaurus*'s thumb claws were short. It could not fight so it probably had to run away.

FOUR-LEGGED CLUES

Besides its strong arms, there are two other clues that show *Camptosaurus* probably walked on all fours.

The first clue is in the dinosaur's skeleton. On the end of its backbone, near its tail, *Camptosaurus* had tiny extra bones. These bones may have helped the dinosaur hold its tail stiff as it walked. A stiff tail would throw an animal that walked on two legs off balance. So *Camptosaurus* would have had trouble walking on two legs.

The second clue solved the mystery. Scientists found footprints that show *Camptosaurus* walking on four legs.



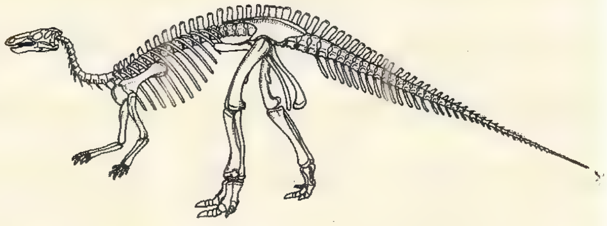
CHECK THESE OUT!

Allosaurus*, Continental drift, Hadrosaurs, *Iguanodon*, Jurassic period, Ornithischian dinosaurs, Ornithopods, *Tenontosaurus*, *Tyrannosaurus

DINOFACTS

Camptosaurus

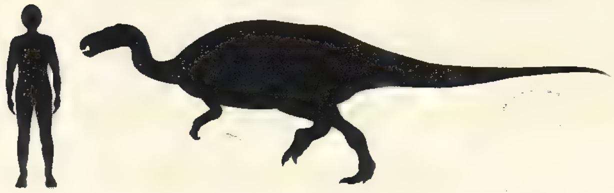
(KAMP-tuh-SORE-us)



▶ ***Camptosaurus* usually moved on four legs, but if it needed to run, it switched to two.**

NAME: ***Camptosaurus* means bent lizard**
kamptos (bent) + sauros (lizard)

FAMILY: **Ornithischian**
Ornithopod



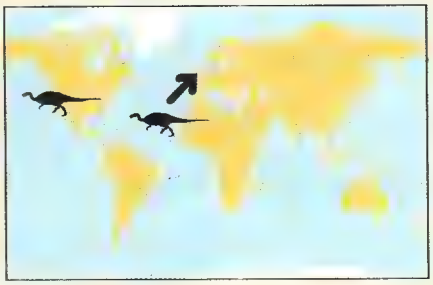
SIZE: 15–20 ft (4.6–6 m) long; 6 ft (1.8 m) high at the hip

WEIGHT: 0.5–1 ton (0.45–0.9 tonnes)—about the same as 1–2 hippopotamuses

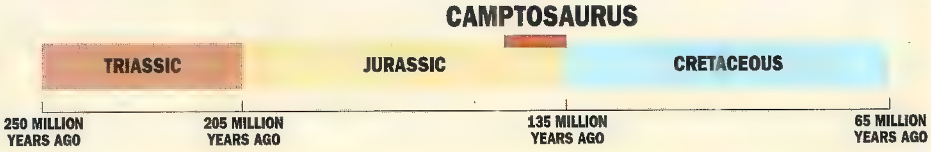
FOOD: plants

HABITAT: open plains with plenty of plants

WHERE: remains found in Colorado, South Dakota, Utah, and Wyoming in the United States, and England



WHEN: 150–135 million years ago in the Jurassic period



Carcharodontosaurus

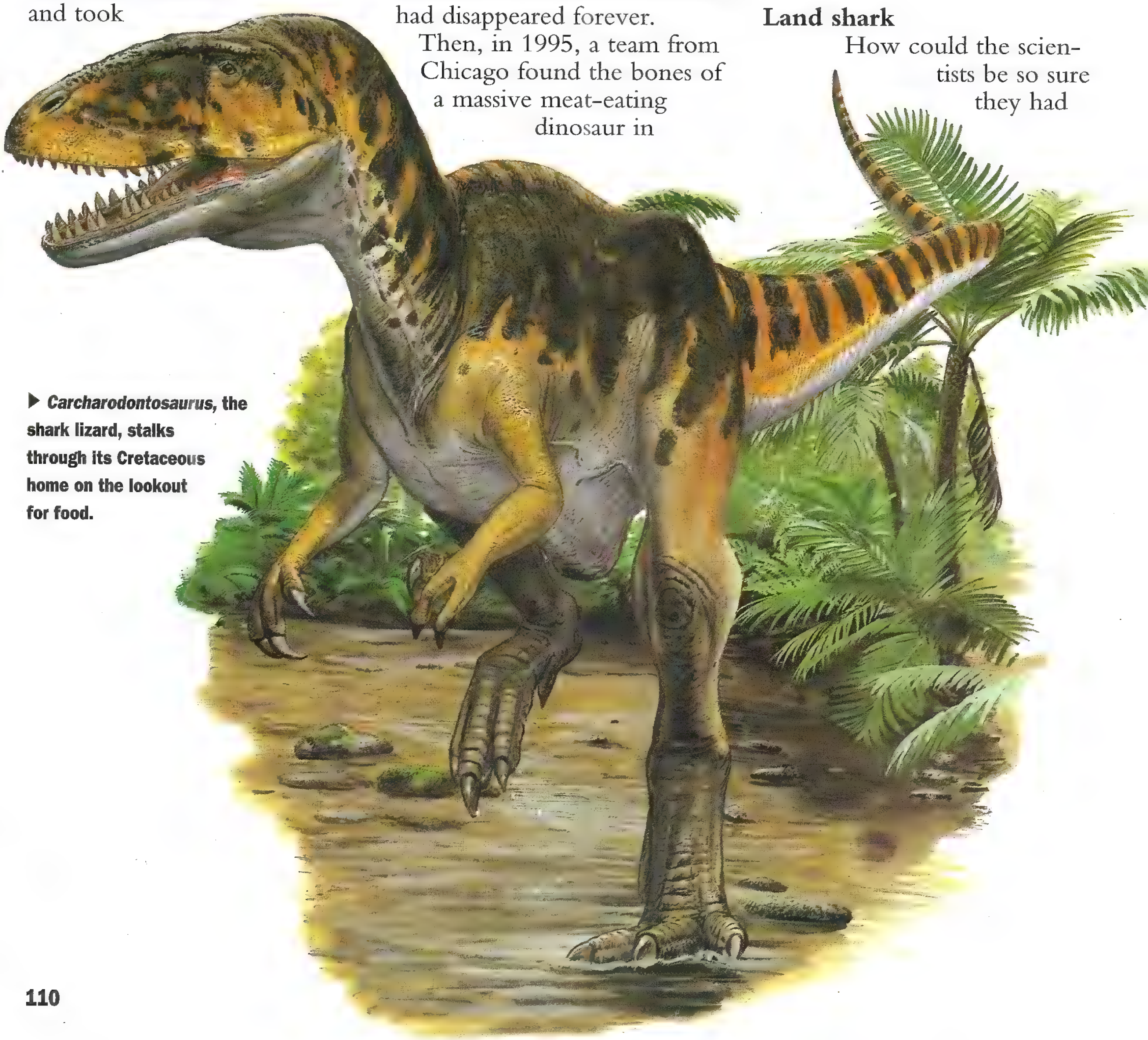
In the Cretaceous period in North Africa, a massive meat-eater was on the loose. Similar in size to *Tyrannosaurus* and *Giganotosaurus*, the shark lizard was one of the most powerful land predators ever.

In 1927, German scientists found the remains of a huge meat-eating dinosaur in Egypt. It was as big as *Tyrannosaurus*. They named the dinosaur *Carcharodontosaurus* and took its bones to the Munich Museum. During a World War II bombing raid, the museum was hit and the dinosaur's remains were destroyed. It seemed that *Carcharodontosaurus* had disappeared forever.

Then, in 1995, a team from Chicago found the bones of a massive meat-eating dinosaur in Morocco in North Africa. What could it be? One look at the jaw and they knew. They had stumbled on another *Carcharodontosaurus*.

Land shark

How could the scientists be so sure they had



▶ ***Carcharodontosaurus*, the shark lizard, stalks through its Cretaceous home on the lookout for food.**

THE CHANGING EARTH

The Chicago fossil-hunting team, led by Paul Sereno, found the remains of *Carcharodontosaurus* in the dry, hot wastes of the Moroccan desert. Believe it or not, when the dinosaur was alive, Morocco could not have looked more different.

***Carcharodontosaurus* hunted near the delta of a river with treelined banks. Living in the river were crocodiles, turtles, crabs, and shrimps.**

found *Carcharodontosaurus*? Because the jaw had teeth like those of a great white shark. Like a shark, *Carcharodontosaurus* had large teeth with jagged edges. The dinosaur got its name because of its teeth. *Troodon* and its relatives also had very jagged teeth.

How did this dinosaur live?
Carcharodontosaurus hunted other dinosaurs. It attacked with its teeth, tearing a huge lump out of its prey. The victim would lose a lot of blood quickly and would collapse.

Scientists have found the remains of a large *Iguanodon*-like animal in the same rocks as *Carcharodontosaurus*. They have also found sauropods—big, long-necked, long-tailed dinosaurs like *Apatosaurus*. *Carcharodontosaurus* probably hunted these plant-eaters.

CHECK THESE OUT!

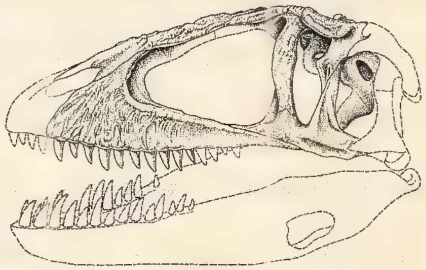
Apatosaurus*, Cretaceous period, *Giganotosaurus*, *Iguanodon*, Saurischian dinosaurs, Sharks, Tetanurans, Theropods, *Troodon*, *Tyrannosaurus

DINOFACTS

Carcharodontosaurus

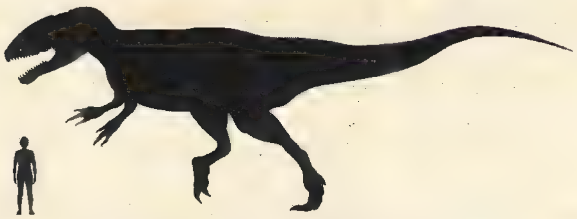
(kar-KAR-o-DON-tuh-SORE-us)

▶ ***Carcharodontosaurus*'s skull was long and narrow. The dinosaur's lower jaw was never found, but each of the teeth in its upper jaw measured 4 in (10 cm).**



NAME: ***Carcharodontosaurus* means shark lizard**
***Carcharodon* (great white shark) + sauros (lizard)**

FAMILY:
- **Saurischian**
  - **Theropod**
    - **Tetanuran**



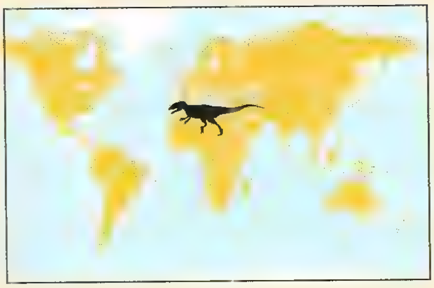
SIZE: 45 ft (13.7 m) long; 13 ft (4 m) high at the hip

WEIGHT: 15 tons (13.6 tonnes) or more—about the same as 45 tigers

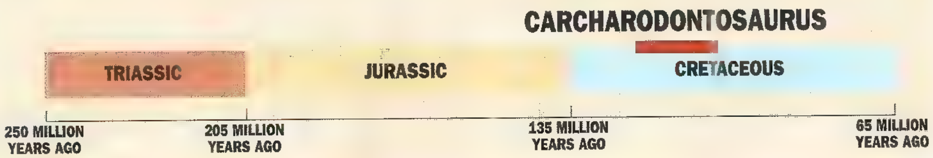
FOOD: meat

HABITAT: swampy lowlands

WHERE: remains found in Algeria, Egypt, and Morocco



WHEN: 115–90 million years ago in the Cretaceous period



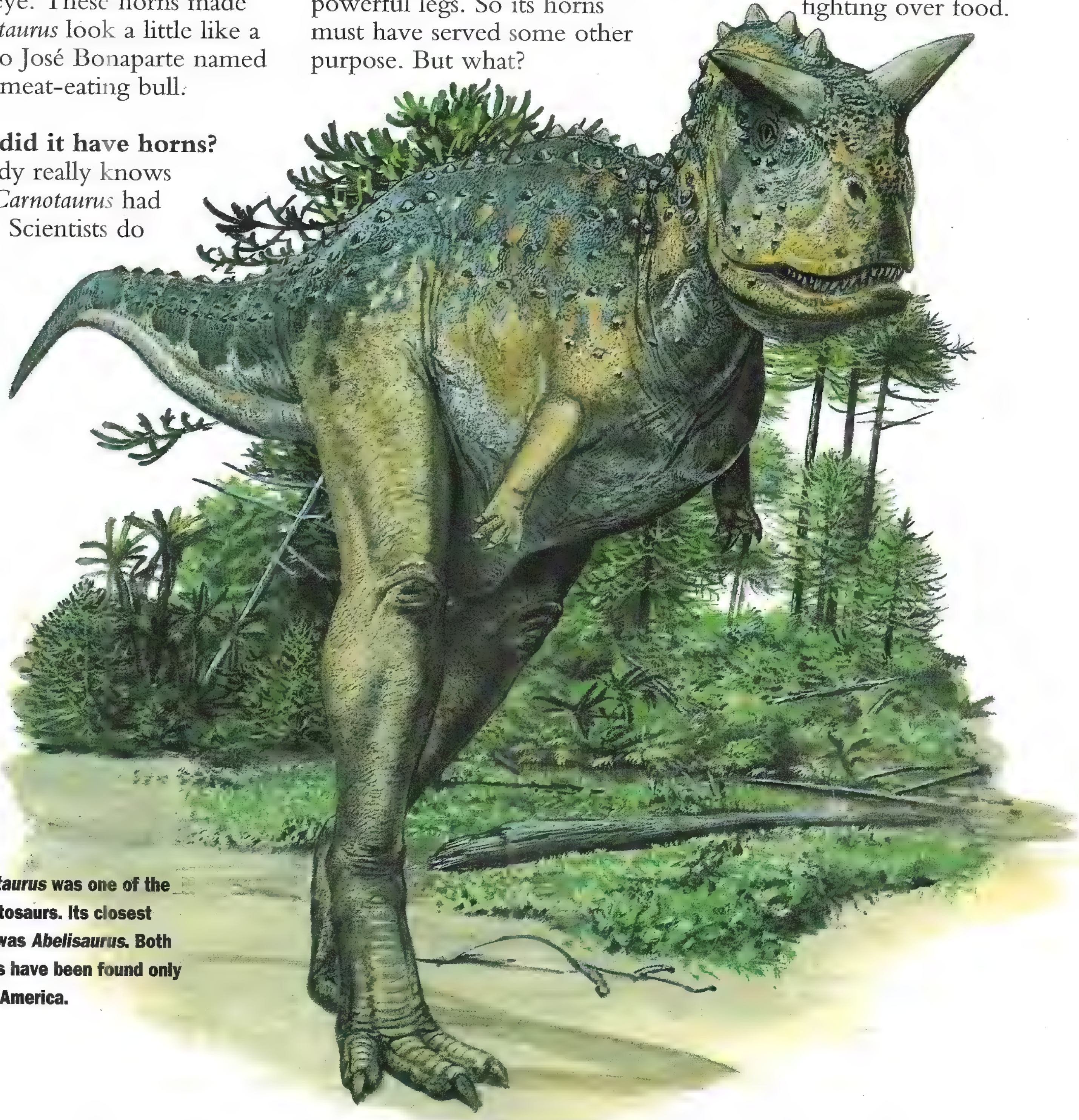
Carnotaurus

In 1985, South American paleontologist José Bonaparte discovered the skeleton of a big meat-eating dinosaur in Argentina. It had horns like a bull, but did it charge like a bull?

Carnotaurus was an unusual-looking dinosaur. It was large, it ate meat, and it had two horns on its head, one above each eye. These horns made *Carnotaurus* look a little like a bull, so José Bonaparte named it the meat-eating bull.

Why did it have horns?
Nobody really knows why *Carnotaurus* had horns. Scientists do not think it used them to attack its prey. *Carnotaurus* probably grabbed its prey with its teeth or kicked at it with its powerful legs. So its horns must have served some other purpose. But what?

Scientists think *Carnotaurus* probably used its horns in head-butting contests with its own kind—perhaps when fighting over food.



▶ ***Carnotaurus* was one of the last ceratosaurs. Its closest relative was *Abelisaurus*. Both dinosaurs have been found only in South America.**

FOSSIL SKIN

When José Bonaparte found the skeleton of *Carnotaurus*, he also found some interesting marks in the rocks around it. These marks were left by the dinosaur's skin.

Remains of dinosaur skin are rare. Dinosaur skin does not fossilize; it decays. However, sometimes the texture of the skin leaves outlines, or imprints, in the rock. Your footprints leave imprints on a sandy beach. What can skin imprints tell us about a dinosaur's skin?

Well, the *Carnotaurus* skin imprints show that this dinosaur's hide was as rough as a cheese grater and was covered with bony bumps. This would have made the skin very tough.

They may also have helped the dinosaurs recognize each other from far away.

How did *Carnotaurus* live?

Carnotaurus was a ceratosaur. Ceratosaurs were meat-eating dinosaurs that had four fingers on each hand.

Carnotaurus hunted for fresh food. Like most meat-eaters, if it found a dead animal, it would probably have eaten that, too.

Scientists are not sure what animals *Carnotaurus* ate. However, it had small teeth for a meat-eating dinosaur of its size. So perhaps it preferred fairly small prey.

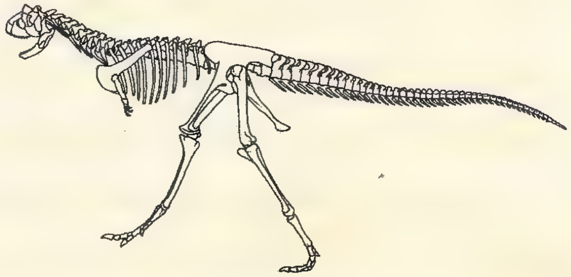
CHECK THESE OUT!

***Abelisaurus*, Ceratosaurs, Cretaceous period, Fossils, Saurischian dinosaurs, Theropods**

DINOFACTS

Carnotaurus

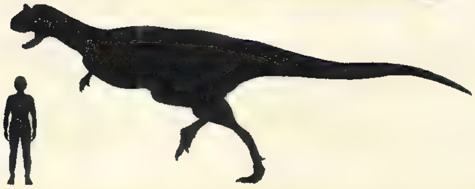
(KAR-noh-TOR-us)



▶ *Carnotaurus* had tiny arms. They were probably too short and weak to catch prey.

NAME: *Carnotaurus* means meat-eating bull
carnis (flesh) + tauros (bull)

FAMILY:
- **Saurischian**
  - **Theropod**
    - **Ceratosaur**



SIZE: 25 ft (7.6 m) long; 7 ft (2.1 m) high at the hip

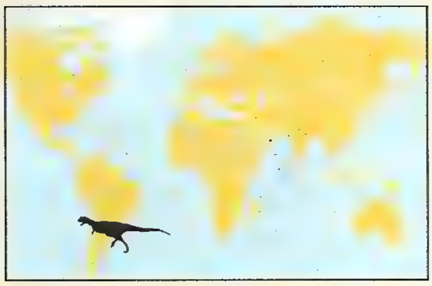
WEIGHT: 1–3 tons (0.9–2.7 tonnes)—about the same as 3–9 tigers

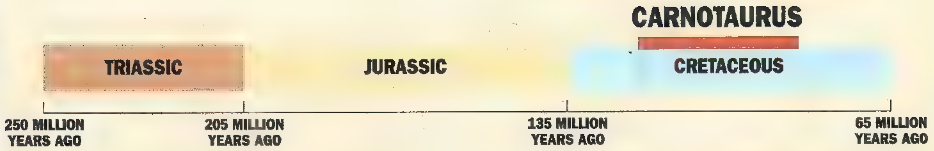
FOOD: meat

HABITAT: lush lowlands

WHERE: remains found in Argentina

WHEN: 115–90 million years ago in the Cretaceous period





Centrosaurus

Ceratopsians, or horned dinosaurs, were numerous during the last few million years of the Cretaceous period. Many different kinds evolved in a short time. One very plentiful kind was *Centrosaurus*.

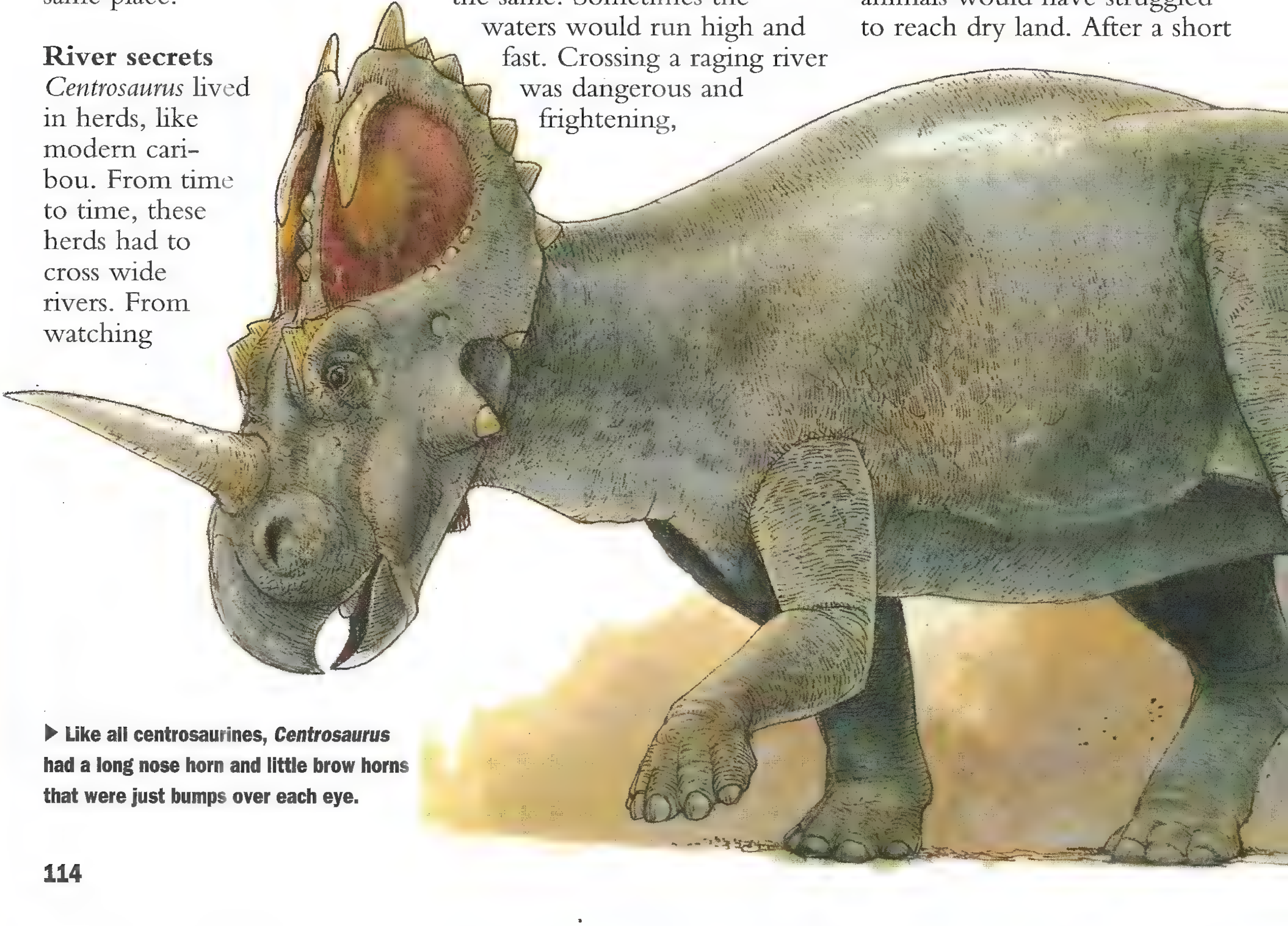
Scientists know *Centrosaurus* was numerous because they sometimes find thousands of its bones at one time. These huge collections of dinosaur fossils are called bone beds. They contain the remains of hundreds of animals. In some places, the rocks contain many bone beds lying one above the other. It seems that large numbers of animals often died at the same time and in the same place.

ALL IN THE FRILL

The large, big-horned ceratopsian dinosaurs belonged to the ceratopsid group. Scientists divide the ceratopsids into two smaller groups—those like *Centrosaurus* (centrosaurines) and those like *Chasmosaurus* (chasmosaurines). The centrosaurines were generally smaller and had shorter neck frills than did the chasmosaurines. *Styracosaurus* was another centrosaurine and a close relative of *Centrosaurus*.

River secrets

Centrosaurus lived in herds, like modern caribou. From time to time, these herds had to cross wide rivers. From watching herds of modern animals, scientists know that they usually cross rivers at the same spot. *Centrosaurus* herds probably did the same. Sometimes the waters would run high and fast. Crossing a raging river was dangerous and frightening, even for big dinosaurs. Imagine the scene as the rushing waters swept away some of the terrified herd. Panicking, these animals would have struggled to reach dry land. After a short



▶ **Like all centrosaurines, *Centrosaurus* had a long nose horn and little brow horns that were just bumps over each eye.**

DINOFACTS

Centrosaurus

(SEN-troh-SORE-us)

NAME: *Centrosaurus* means well-horned lizard
centro (well-horned) + sauros (lizard)

FAMILY: **Ornithischian**
Ceratopsian

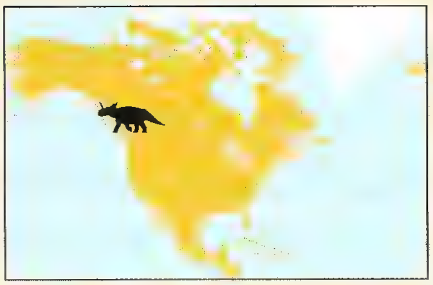
SIZE: 20 ft (6 m) long; about 6 ft (1.8 m) high at the hip

WEIGHT: 2–3 tons (1.8–2.7 tonnes)—about the same as 1–2 white rhinoceroses

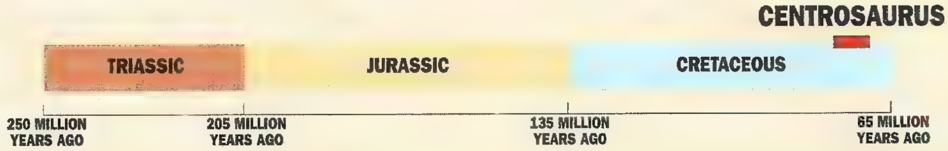
FOOD: plants

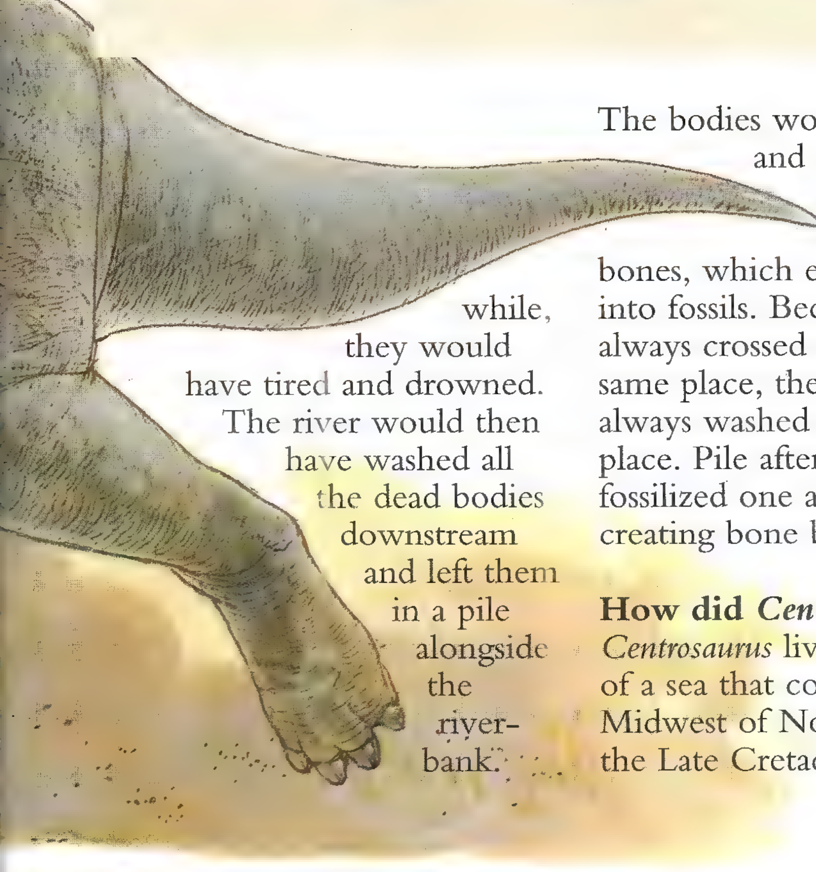
HABITAT: swampy, broad coastal plains

WHERE: remains found in Alberta, Canada



WHEN: 80–70 million years ago in the Cretaceous period





while, they would have tired and drowned. The river would then have washed all the dead bodies downstream and left them in a pile alongside the riverbank. The bodies would have rotted, and silt and mud would have covered the bones, which eventually turned into fossils. Because the herds always crossed the river at the same place, the dead bodies always washed up at the same place. Pile after pile of bones fossilized one above the other, creating bone beds.

How did *Centrosaurus* live? *Centrosaurus* lived on the coast of a sea that covered the Midwest of North America in the Late Cretaceous period. Large rivers flowed into this sea, and the land along its edge was covered with forests and swamps. Food was plentiful. Even so, *Centrosaurus* had an enormous appetite, and the herds would have run out of food if they stayed in one place for long. *Centrosaurus* herds were always moving on in search of more plants to eat.

CHECK THESE OUT!

Ceratopsians, *Chasmosaurus*, Cretaceous period, Fossils, Ornithischian dinosaurs, *Styracosaurus*

Ceratopsians

Ceratopsians lived fairly late in the age of the dinosaurs. Some were the last dinosaurs to walk the earth. Ceratopsians came in all shapes and sizes from the tiny *Microceratops* to the mighty *Triceratops*.

Ceratopsians are often called the horned dinosaurs. However, not all ceratopsians had horns. *Psittacosaurus* was a hornless ceratopsian.

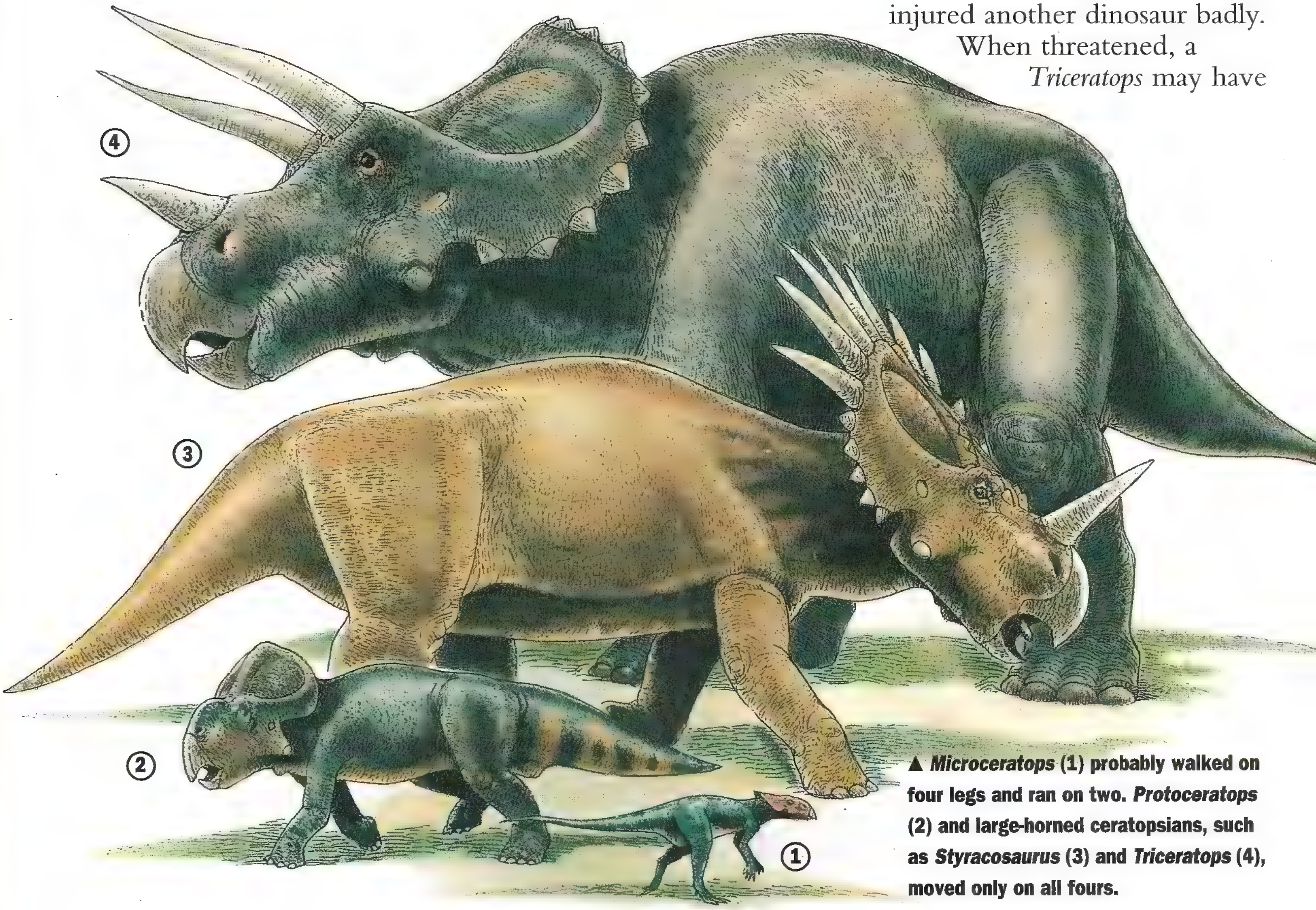
So why do scientists call *Psittacosaurus* a ceratopsian if it had no horns? *Psittacosaurus* was an early ceratopsian. The horns appeared only in later animals.

Psittacosaurus lived in the Early Cretaceous period. The big-horned ceratopsians, like *Triceratops*, lived at the end of the Cretaceous period. In between came another group of ceratopsians. These had only small horns and sometimes none at all. *Protoceratops* belonged to the middle group.

How did ceratopsians live?
Ceratopsians were plant-eating dinosaurs. Smaller types, such as *Protoceratops*, would have tried to run away if attacked. However, *Velociraptor* would have caught them.

Scientists believe the large, big-horned ceratopsians used their horns as weapons. A ceratopsian horn could have injured another dinosaur badly.

When threatened, a *Triceratops* may have



▲ ***Microceratops* (1) probably walked on four legs and ran on two. *Protoceratops* (2) and large-horned ceratopsians, such as *Styracosaurus* (3) and *Triceratops* (4), moved only on all fours.**

dipped its head and charged, like a modern rhinoceros.

Ceratopsians may also have fought one another to show who was strongest. They would lock horns and wrestle, or pretend to charge.

A ceratopsian puzzle

Most horned dinosaurs had bony plates called frills sticking out from their skull. Scientists think that ceratopsians used them as a warning. If another dinosaur got too close, a ceratopsian could wave its huge head and frill to warn, "Stay away. I'm stronger than you."

Frills also had another important job. They held the big jaw muscles ceratopsians needed to chew their food.

CHEEKS AND TEETH

Ceratopsians were unusual dinosaurs because they could chew their food. They could do this because they had cheeks—that is, loose skin around the jaws. Cheeks allow animals to keep food in their mouth while the teeth do their work. Most dinosaurs had no cheeks. Their teeth were at the edge of their mouth. If they had tried to chew, their food would have spilled out. So most dinosaurs had to swallow their food in a single chunk.

CHECK THESE OUT!

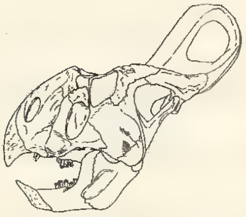
Anchiceratops*, *Arrhinoceratops*, *Bagaceratops*, *Brachyceratops*, *Centrosaurus*, Cretaceous period, *Einiosaurus*, *Leptoceratops*, Ornithischian dinosaurs, *Pachyrhinosaurus*, *Pentaceratops*, *Protoceratops*, *Psittacosaurus*, *Styracosaurus*, *Torosaurus*, *Triceratops*, *Velociraptor

DINOFACTS

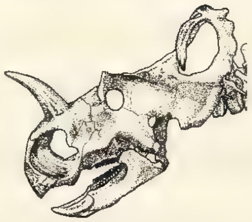
Ceratopsians

(*SEH-ruh-TOPE-see-yuns*)

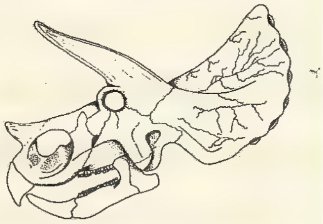
▼ Look at the skulls of these ceratopsians below. Can you spot all the differences between them?



1. *Protoceratops* had a horn that was just a little bump on its nose.



2. *Centrosaurus* had a single, large nose horn and bumps over its eyes.



3. *Triceratops* had a small nose horn and a brow horn over each eye.

NAME: Ceratopsian means horned-face
keratos (horned) + ops (face)

FAMILY: Ornithischian

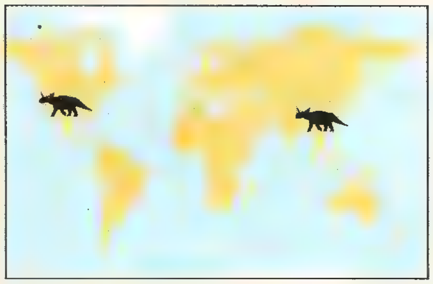
SIZE: 30 in to 30 ft (76 cm to 9.1 m) long; 1–9 ft (30 cm to 2.7 m) high at the hip

WEIGHT: huge variation from 9 lb (4 kg) to 10 tons (9 tonnes)

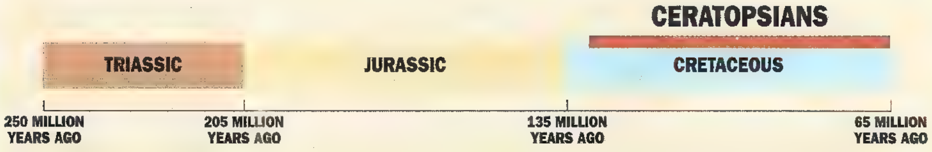
FOOD: plants

HABITAT: wide-ranging from semidesert to lush plains

WHERE: remains found in North America and Asia



WHEN: 130–65 million years ago in the Cretaceous period



Ceratosaurs

Ceratosaurs were theropods—two-legged meat-eating dinosaurs. They were lightly built and had long back legs. The ceratosaurs were very speedy and successful hunters.

The ceratosaur group lived for more than 130 million years. They were the first theropod (two-legged meat-eating) dinosaurs. They survived longer than any other group of theropods.

The ceratosaur group included dinosaurs like *Coelophysis*, *Dilophosaurus*, *Carnotaurus*, and *Ceratosaurus* itself.

Ceratosaurs first appeared in the Late Triassic period more than 220 million years ago. By the Early Jurassic period (about 190 million years ago) the ceratosaurs were the most common theropod dinosaurs around.

Fingers and thumbs

Allosaurus and *Tyrannosaurus* were huge, muscular theropods. Ceratosaurs were smaller and lighter. They also had four fingers on each hand. One of these fingers worked like a human thumb. Scientists think that ceratosaurs, especially small ones, may have used their hands to catch and hold their food.

Ceratosaurs had four fingers because they were primitive theropods. Advanced theropods like *Tyrannosaurus* had only two fingers on each hand and no thumb. They used their huge head and teeth to catch their prey.

Horns and crests

The name *ceratosaur* means "horned lizard." Many ceratosaurs had horns or crests on their head. Mostly, these growths were too weak to use for fighting. So why did ceratosaurs have horns or crests? Scientists think they may have helped one ceratosaur recognize another of its own kind.

How did ceratosaurs live?

Fossil-hunters have found the bones of many ceratosaurs in one clump. They found a clump of

◄ Ceratosaurs, such as *Dilophosaurus* and *Coelophysis* (one of the earliest dinosaurs), were fast, powerful runners. There were few plant-eaters that were quick enough to outrun them.

Coelophysis in New Mexico, and a clump of *Syntarsus* in southern Africa. Scientists think these discoveries show that ceratosaurs lived in groups.

Why would ceratosaurs have lived in groups? By hunting in packs, they may have been able to kill larger prey than a single ceratosaur could.

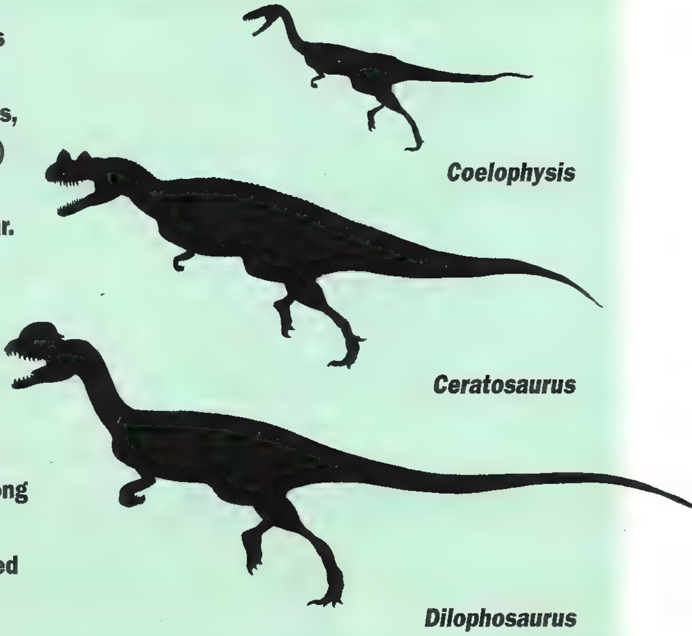
CHECK THESE OUT!

Abelisaurus*, *Allosaurus*, *Carnotaurus*, *Ceratosaurus*, *Coelophysis*, Cretaceous period, *Dilophosaurus*, *Elaphrosaurus*, Jurassic period, *Majungatholus*, Saurischian dinosaurs, Sauropods, *Syntarsus*, Theropods, Triassic period, *Tyrannosaurus

SHAPE AND SIZE OF CERATOSAURS

Ceratosaurs came in many different sizes. Some, such as *Coelophysis* (top), were no bigger than a large dog. Others, such as *Ceratosaurus* (middle) or *Dilophosaurus* (bottom), were bigger than a grizzly bear.

All ceratosaurs were theropods. While their size varied, their body shapes were similar. The typical ceratosaur had powerful hind legs for running. It had a long tail, a long body, and a long neck. A ceratosaur's long, narrow body would have helped it run fast.



DINOFACTS

Ceratosaur

(seh-RAT-oh-sore)

NAME: Ceratosaur means horned lizard keratos (horned) + sauros (lizard)

FAMILY: Saurischian → Theropod

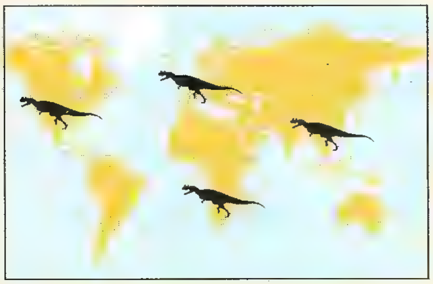
SIZE: 11–20 ft (3.4–6 m) long; 1.5–5 ft (0.5–1.5 m) high at the hip

WEIGHT: large variation from 34 lb (15.4 kg) to 1 ton (0.9 tonnes)—or, from a large dog to 2 grizzly bears

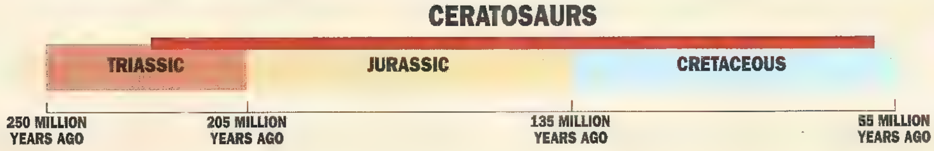
FOOD: meat

HABITAT: fairly arid locations

WHERE: remains found in North America, Europe, southern Africa, and Asia, but ceratosaurs may have lived all over the world



WHEN: 225–70 million years ago in the Late Triassic, the Jurassic, and the Cretaceous periods



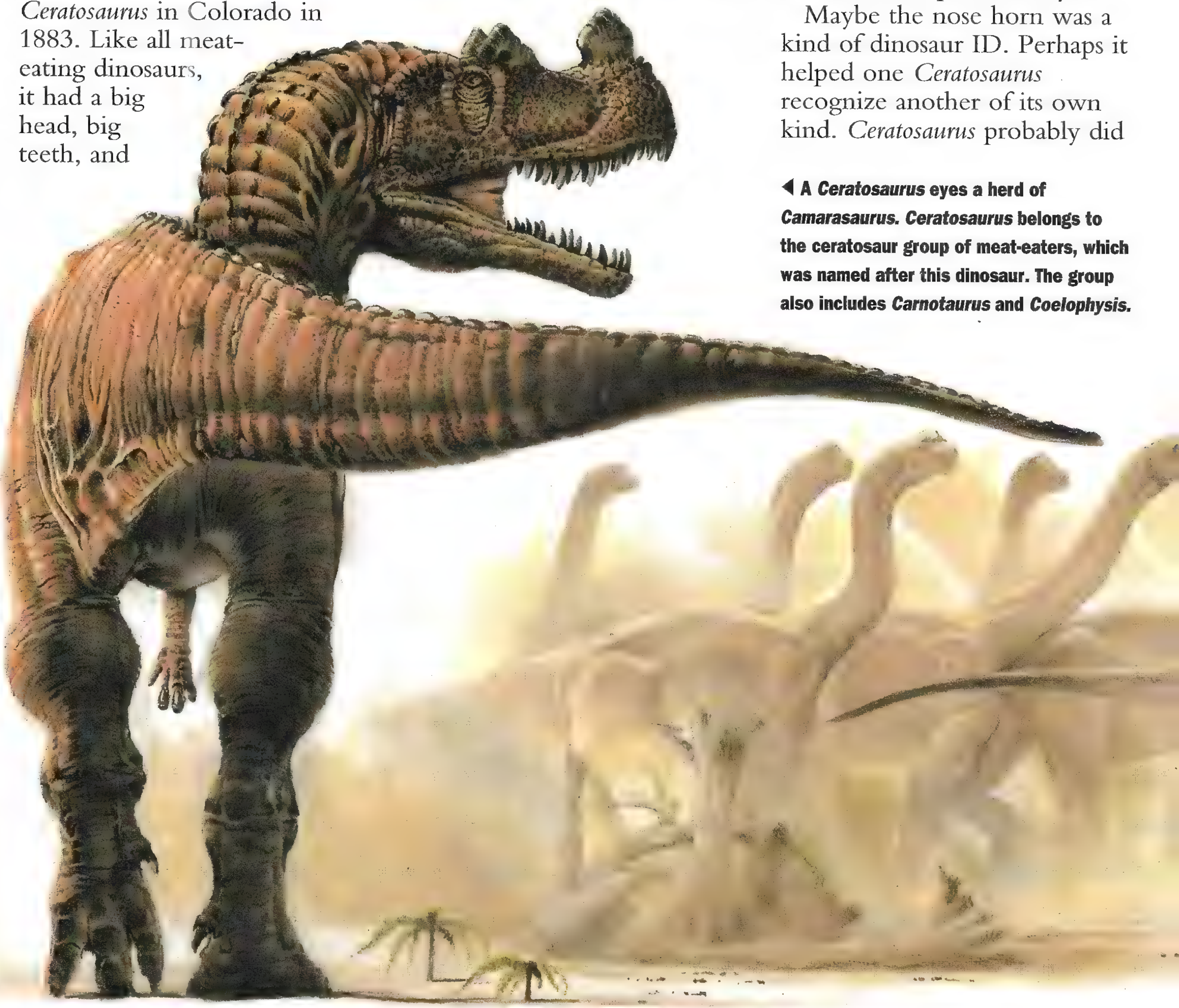
Ceratosaurus

Ceratosaurus was a theropod—a two-legged meat-eating dinosaur. Like other large meat-eaters, it had a big head and big teeth. It was the only meat-eater with a horn.

Ceratosaurus belongs to the ceratosaur group of meat-eaters, which also includes *Carnotaurus*, *Coelophysis*, and *Dilophosaurus*. Fossil-hunters first found the remains of *Ceratosaurus* in Colorado in 1883. Like all meat-eating dinosaurs, it had a big head, big teeth, and powerful hind legs to chase its prey. It also had a large horn at the end of its snout.

No other meat-eating dinosaur had a nose horn. So why did *Ceratosaurus* have one? Scientists can only guess. Perhaps the nose horn was used for show. Maybe males used it to attract females during the mating season, as some African antelope do today.

Maybe the nose horn was a kind of dinosaur ID. Perhaps it helped one *Ceratosaurus* recognize another of its own kind. *Ceratosaurus* probably did



◀ A *Ceratosaurus* eyes a herd of *Camarasaurus*. *Ceratosaurus* belongs to the ceratosaur group of meat-eaters, which was named after this dinosaur. The group also includes *Carnotaurus* and *Coelophysis*.

ARMOR PLATING

Besides being the only theropod with a nose horn, *Ceratosaurus* was also the only theropod with armor plates. These small, bony plates were lined along the dinosaur's back.

Why did *Ceratosaurus* have armor plates? Scientists are not sure. The plates were probably too small to give protection. However, the dinosaur may have showed them off like peacock feathers during the mating season.

not use its horn for fighting. The horn was too small for that and not especially strong.

How did *Ceratosaurus* live?
Ceratosaurus was a hunter. It probably wandered in search of animals to eat. It may have hunted in packs, or it may have hunted alone. A pack of *Ceratosaurus* could bring down large sauropods like *Apatosaurus* or *Camarasaurus*. A single *Ceratosaurus* probably could not have killed an *Apatosaurus*. So if *Ceratosaurus* did work alone, it might have hunted smaller dinosaurs such as *Camptosaurus*, a medium-sized plant-eater.

CHECK THESE OUT!

***Apatosaurus*, *Camarasaurus*, *Camptosaurus*, *Carnotaurus*, Ceratosaurs, *Coelophysis*, *Dilophosaurus*, Jurassic period, Saurischian dinosaurs, Theropods**

DINOFACTS

Ceratosaurus

(seh-RAT-oh-SORE-us)

NAME: *Ceratosaurus* means horned lizard
keratos (horned) + sauros (lizard)

FAMILY: Saurischian
Theropod
Ceratosaur

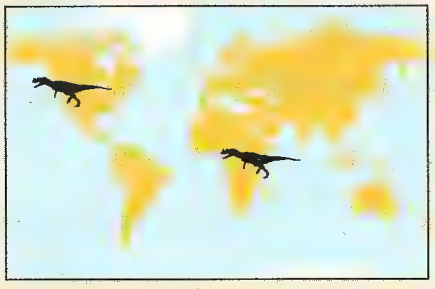
SIZE: 15–20 ft (4.6–6 m) long; 5 ft (1.5 m) high at the hip

WEIGHT: 0.5–1 ton (0.45–0.9 tonnes)—about the same as 2–4 lions

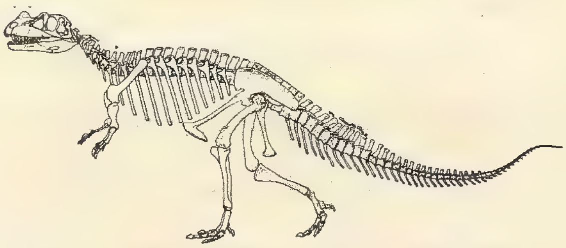
FOOD: meat

HABITAT: lowland open forest

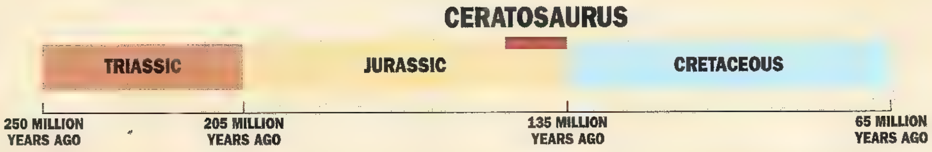
WHERE: remains found in Colorado in the United States, and East Africa



▼ *Ceratosaurus* had a long, flexible tail. It may have used its tail for swimming.



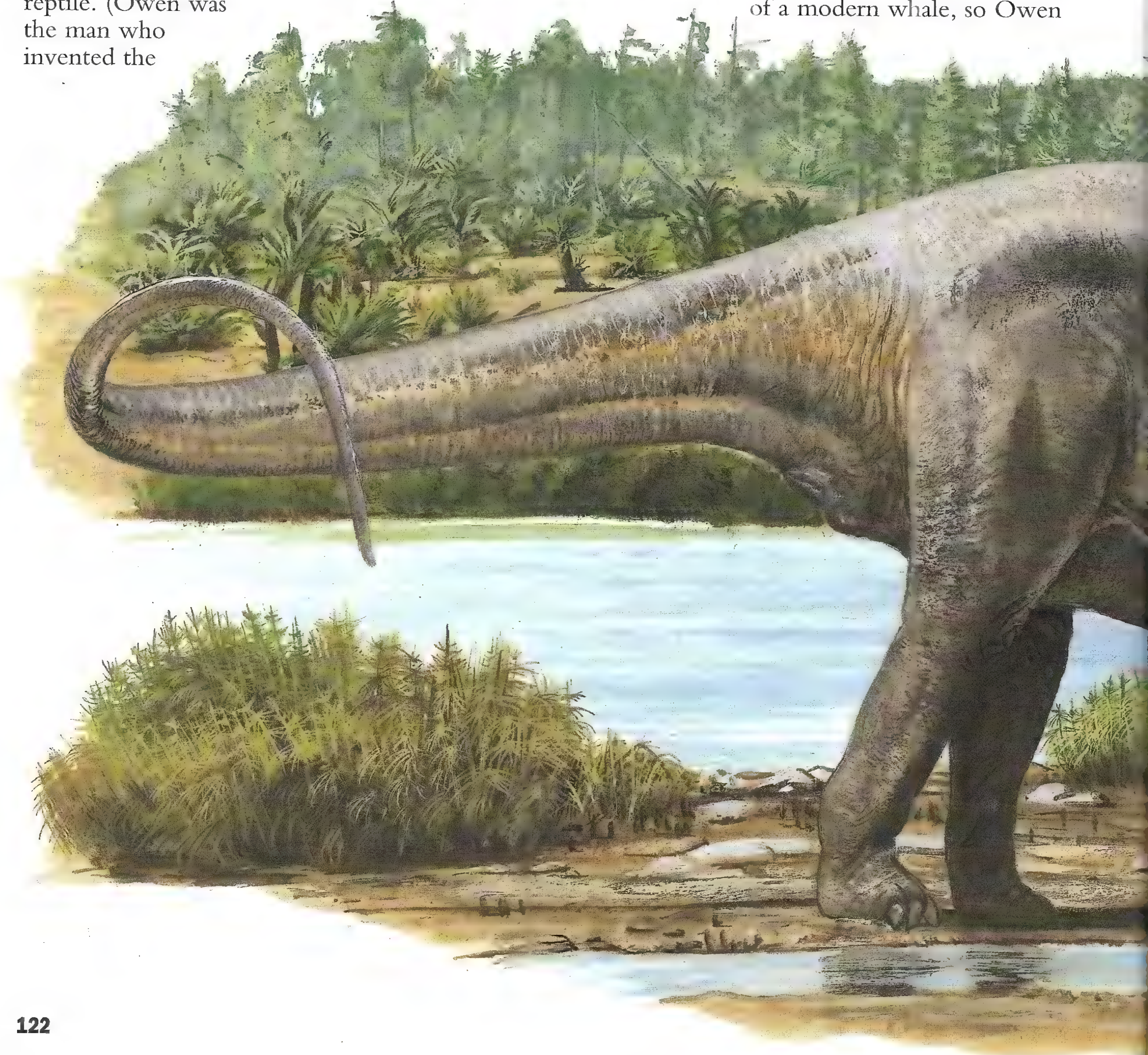
WHEN: 225–145 million years ago in the Jurassic period



Cetiosaurus

Cetiosaurus was found in the 1830s and was one of the first dinosaurs to be named. Yet for years, scientists did not realize that *Cetiosaurus* was a dinosaur. They believed it was something else entirely.

In 1841, in the early days of paleontology, the British scientist Richard Owen studied the remains of a large plant-eating reptile. (Owen was the man who invented the name *dinosaur,* or "terrible lizard.") When first discovered in the 1830s, the remains had been identified as whale bones. Owen disagreed. He thought the bones belonged to a giant crocodilelike creature. Its back bones were rough, like those of a modern whale, so Owen



called the remains *Cetiosaurus*, or whale lizard.

Thirty years later, fossil-hunters discovered a more complete *Cetiosaurus* skeleton that showed that the animal was neither a whale nor a crocodile. *Cetiosaurus* was a sauropod, a long-necked, long-tailed plant-eating dinosaur with strong, thick legs.

The scientists imagined that *Cetiosaurus* spent most of its time wallowing in water like some prehistoric hippo. How else could it have carried its heavy body around? Scientists now know that *Cetiosaurus* and other sauropods were fully at home on land. *Cetiosaurus* may have wallowed in the water, but it did not have to stay there because of its size.

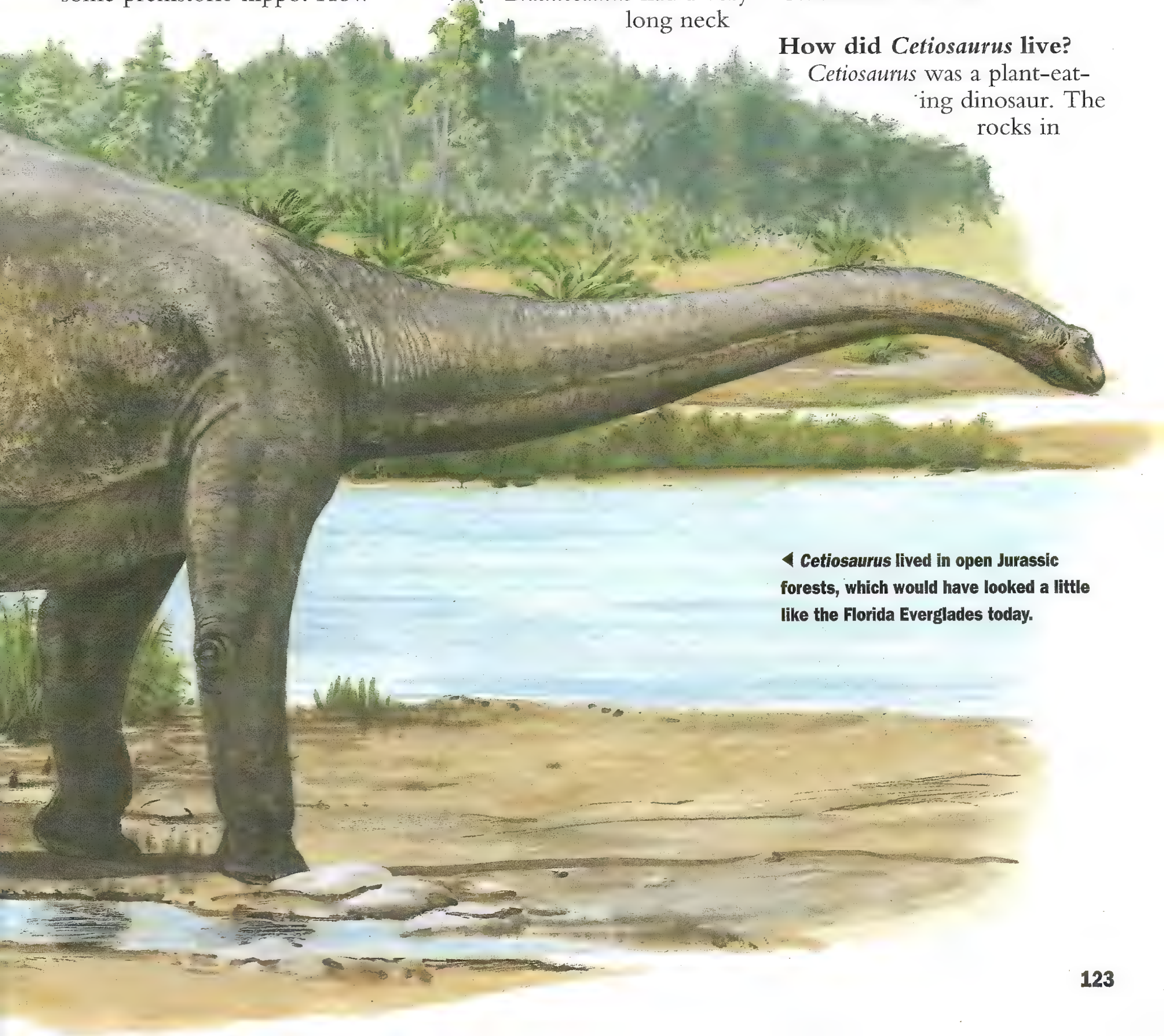
An average sauropod

Many kinds of sauropods had features that made them stand out from the rest. *Barosaurus* had a very long neck. *Brachiosaurus* had a very long neck and forelegs. *Diplodocus* and its relatives had whiplash tails. *Cetiosaurus* was different. It had a long neck and a short tail. Its forelegs were only slightly longer than its hind legs.

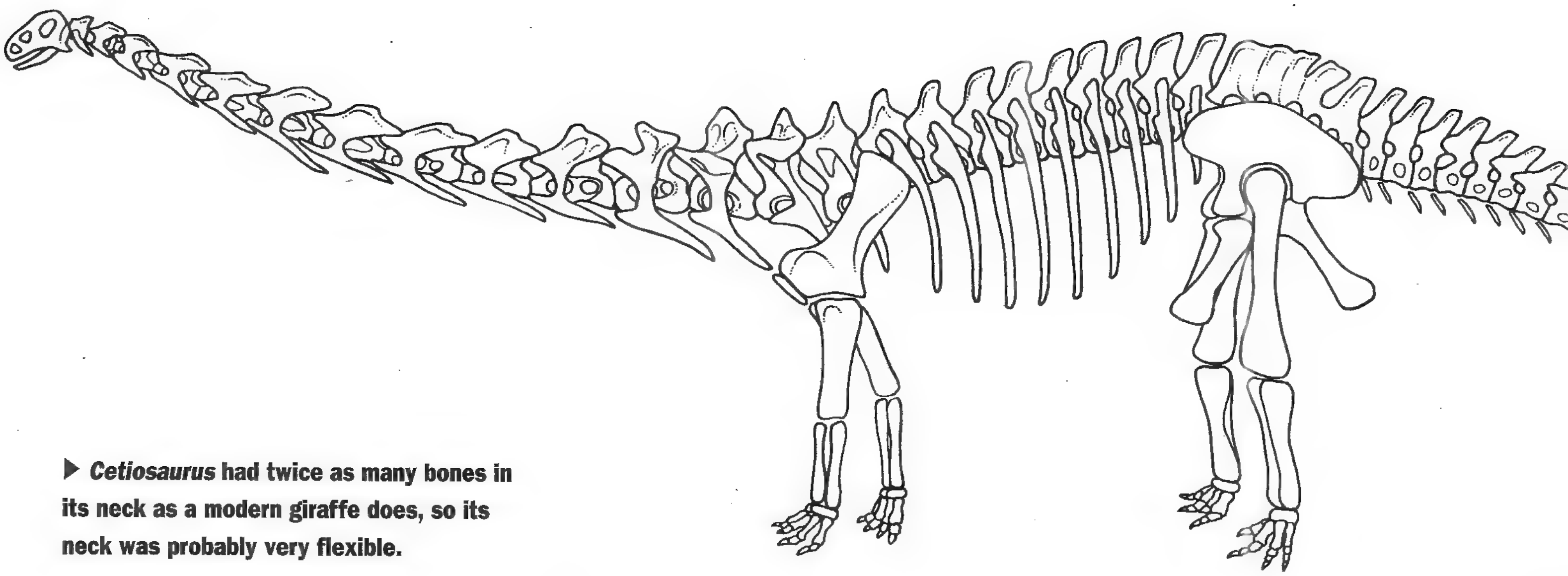
Why did *Cetiosaurus* not have any special traits? Perhaps because it was a primitive sauropod. The sauropods described above did not appear until some time later in the Jurassic period, about 20 million years after the last *Cetiosaurus* had died.

How did *Cetiosaurus* live?

Cetiosaurus was a plant-eating dinosaur. The rocks in



◀ ***Cetiosaurus* lived in open Jurassic forests, which would have looked a little like the Florida Everglades today.**



▶ ***Cetiosaurus* had twice as many bones in its neck as a modern giraffe does, so its neck was probably very flexible.**

which fossil-hunters have found *Cetiosaurus* bones provide many clues about what the dinosaur ate.

Fossil-hunters have discovered the remains of Jurassic plants in these rocks. The plants included horsetails, a type of fern, and conifers. There was also tree pollen.

Cetiosaurus could have eaten all of these foods, or perhaps just some of them.

The dinosaur would have moved slowly from tree to tree, cutting off bunches of rough leaves with its teeth.

A primitive sauropod, *Cetiosaurus* had teeth at the front of its jaws and along the sides as well. Later sauropods had teeth only at the front of their jaws. Sauropods could not chew their food. They swallowed it whole. The loss of teeth may be linked with a change in feeding habits, although scientists cannot tell if it was the main reason.

SAUROPODS' TINY BRAINS

Sauropods seemed to have very small heads. *Cetiosaurus*'s head was the same size as a modern horse's head. It was not really small. It just looked small compared to the rest of the dinosaur.

Sauropods had small brains, though. Their brains were the size of a cat's—a staggering 100,000 times smaller than the dinosaur's body. Sauropods were the least brainy dinosaurs. They did not need to be clever because their size protected them from most meat-eaters.

Their heads in the clouds?
Scientists disagree over how high *Cetiosaurus* could reach.

Many of them think that *Brachiosaurus* could hold its long neck straight upward. However, unlike *Brachiosaurus*, *Cetiosaurus* might not have had a strong enough heart to pump its blood all the way up its neck to raise its head up high.

Cetiosaurus may have had to carry its neck level with the ground, holding its head down low. A fully grown *Cetiosaurus* might have reached only about 15 ft (4.6 m) up a tree.

Only a sauropod could reach that far while standing on the ground, so *Cetiosaurus* would have had an advantage. Even so, the advantage would have been small.

Too small, according to some paleontologists. They

argue that the only reason plant-eaters have long necks is so they can reach high into trees. A sauropod needed a lot of energy to carry around its long neck. It would have been a waste to have such a long neck just to hold it level with the ground.

That makes sense, too. So who is right? Scientists, like detectives, often make guesses. Then they have to dig for more information to find out what really happened.

The world of *Cetiosaurus*

Who were *Cetiosaurus*'s neighbors? To find the answer, scientists studied a site in England where they had found remains of *Cetiosaurus*. They discovered that the place had been a pond in Jurassic times. It had been full of fish, of course, but turtles and even crocodiles had lived there, too. The scientists also found the bones of lizards, small mammals, mammal-like reptiles, and the meat-eating dinosaur *Megalosaurus*, which may have hunted *Cetiosaurus*. Like *Cetiosaurus*, all these animals were probably washed into the pond after they died.

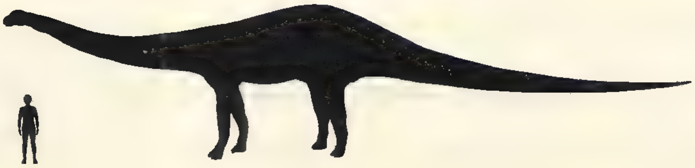
DINOFACTS

Cetiosaurus

(SEE-tee-oh-SORE-us)

NAME: ***Cetiosaurus*** **means whale lizard**
ketios (whale) + sauros (lizard)

FAMILY:
- **Saurischian**
  - **Sauropodomorph**
    - **Sauropod**



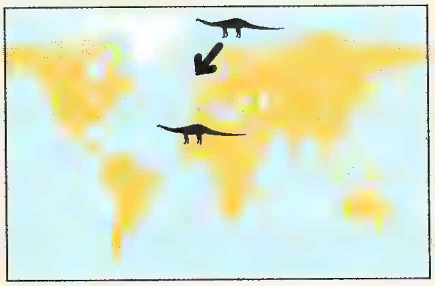
SIZE: 50–60 ft (15.2–18.3 m) long; 15 ft (4.6 m) high at the hip

WEIGHT: 10–40 tons (9–36 tonnes)—about the same as 2–8 African elephants

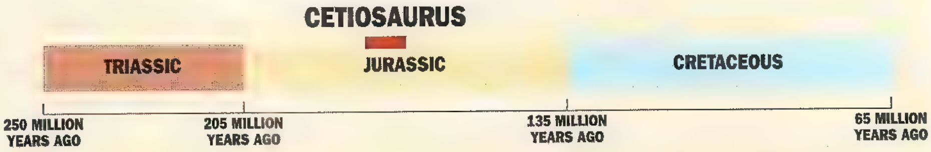
FOOD: plants

HABITAT: lowland open forest

WHERE: remains found in Morocco, North Africa; and England



WHEN: 180–170 million years ago in the Jurassic period



CHECK THESE OUT!

Barosaurus**,** ***Brachiosaurus*****, Crocodiles,** ***Diplodocus*****, Jurassic period, Lizards and snakes, Mammals, Mammal-like reptiles, Plants, Sauropods, Turtles**

Chasmosaurus

Remains of *Chasmosaurus* were first discovered in 1901. *Chasmosaurus* was a ceratopsian, or horned dinosaur, and lived in what is now Texas and western Canada near the end of the age of the dinosaurs.

Chasmosaurus, like *Triceratops*, was one of the big-horned ceratopsians that lived at the end of the Cretaceous period. These ceratopsians had bony lumps, or frills, at the back of their head and were divided into short-frilled and long-frilled types.

Chasmosaurus was the earliest long-frilled type, so long-frilled ceratopsians are known as chasmosaurines. *Chasmosaurus*'s body was not very large for a ceratopsian, but its head was 5 ft (1.5 m) long. Its frill was as long as its face.

Different horns

Chasmosaurus usually had a nose horn and two brow horns, one above each eye.

Scientists have studied several *Chasmosaurus* skulls. The brow horns came in different sizes and shapes. Some skulls had small, blunt brow horns. Other skulls had long, pointed brow horns.

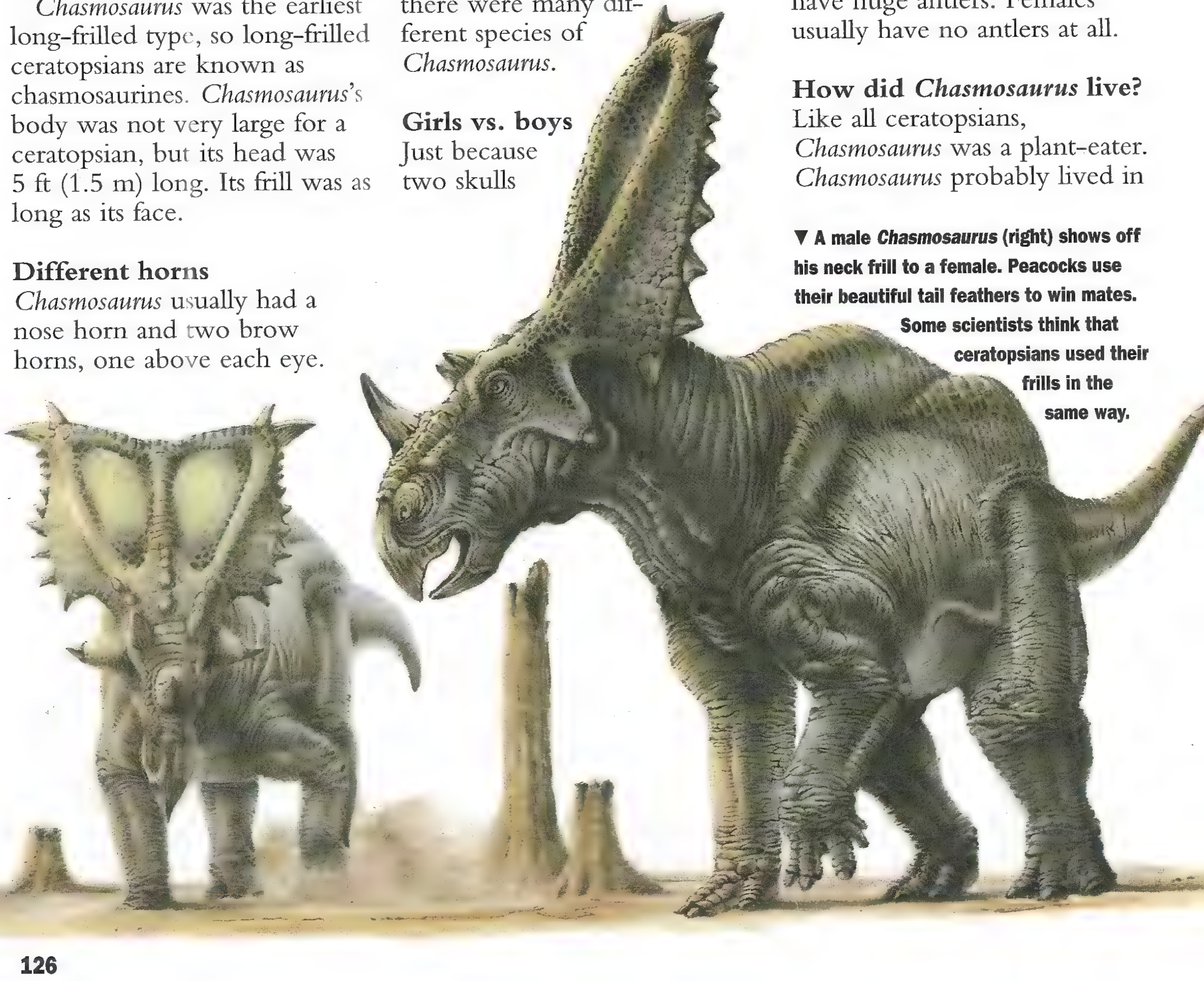
Scientists thought that all these different horns meant there were many different species of *Chasmosaurus*.

Girls vs. boys

Just because two skulls have different horns doesn't always mean they belong to different species. Male and female animals of the same species may also have had different horns. Males and females of modern animals sometimes look different. Think of deer. Males often have huge antlers. Females usually have no antlers at all.

How did *Chasmosaurus* live?

Like all ceratopsians, *Chasmosaurus* was a plant-eater. *Chasmosaurus* probably lived in



▼ A male *Chasmosaurus* (right) shows off his neck frill to a female. Peacocks use their beautiful tail feathers to win mates. Some scientists think that ceratopsians used their frills in the same way.

DINOFACTS

Chasmosaurus

(KAZ-moh-SORE-us)

✳ **NAME:** *Chasmosaurus* means opening lizard
chasma (opening) + sauros (lizard)

○ **FAMILY:** Ornithischian
Ceratopsian

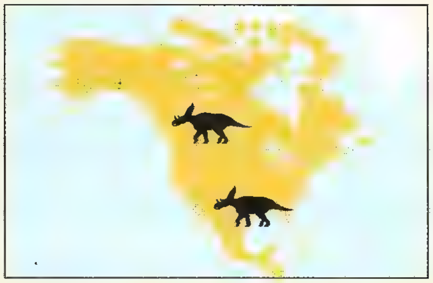
SIZE: 17 ft (5.2 m) long; 6 ft (1.8 m) high at the hip

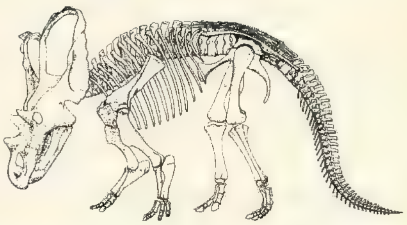
WEIGHT: 2.5 tons (2.3 tonnes)—about the same as a white rhinoceros

FOOD: plants

HABITAT: lowlands, river floodplains, and near river deltas

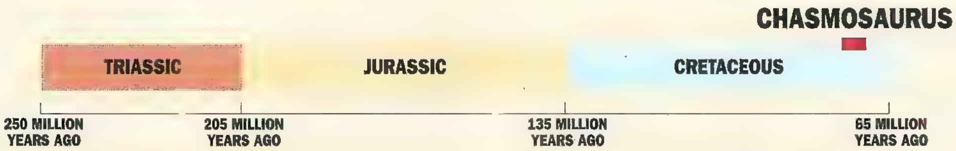
WHERE: remains found in Alberta, Canada; and Texas





▶ The frill of *Chasmosaurus* had very large openings in it. The dinosaur was named after these openings.

WHEN: 75–70 million years ago in the Cretaceous period



large herds, as do modern wildebeest or North American bison. When a meat-eating dinosaur appeared, the adult ceratopsians may have formed a defensive circle around their young to keep them safe.

CHECK THESE OUT!

Ceratopsians, Cretaceous period, Crocodiles, Fossils, Ornithischian dinosaurs, *Triceratops*

MASS GRAVES

Fossil-hunters often find remains of *Chasmosaurus* in what are called bone beds. Bone beds are like mass graves. They are sections of rock that are full of fossilized bones. Some bone beds have contained the remains of more than 100 dinosaurs of the same *Chasmosaurus* species. How could the skeletons of so many dinosaurs of the same kind come to be in one place?

All the *Chasmosaurus* remains in each bone bed were found close together in rocks of the same age, so scientists decided that all the dinosaurs in each bed died at the same time. Perhaps a herd of *Chasmosaurus* died while crossing a river. Like modern herd animals, *Chasmosaurus* probably moved from place to place searching for food. Today, wildebeest herds suffer many deaths when crossing rivers. Some animals drown. Others are caught by meat-eaters such as crocodiles.

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